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UNDERSTANDING EDUCATION ABROAD WITH ADVANCED QUANTITATIVE METHODOLOGIES: STUDENT PROFILES AND ACADEMIC OUTCOMES

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UNDERSTANDING EDUCATION ABROAD WITH ADVANCED QUANTITATIVE METHODOLOGIES: STUDENT PROFILES AND ACADEMIC OUTCOMES

DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
College of Education
at the University of Kentucky

By

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ABSTRACT OF DISSERTATION

UNDERSTANDING EDUCATION ABROAD WITH ADVANCED QUANTITATIVE METHODOLOGIES: STUDENT PROFILES AND ACADEMIC OUTCOMES

This three-study dissertation contributes to the research in the field of participation in education abroad, particularly as it relates to student profiles and academic outcomes. Through employing more robust methodologies across the three studies, this dissertation aims not only to understand what are the factors associated with education abroad participation and how these factors interplay with each other, but also to provide a less biased picture of the impact of participation in education abroad on postsecondary educational outcomes. The studies have implications for equitable and inclusive access to education abroad.

The first study begins with the question: who studies abroad? Using logistic regression and classification and regression tree, the first study examines the average effect of each independent variable on the likelihood of education abroad participation, and also captures the complex interactive effects among independent variables. The findings of this study provide implications for education abroad policy makers and practitioners to understand student level barriers to education abroad participation. For example, students who academically performed well are more likely to study abroad, yet students with lower academic performance also benefit academically from study abroad. This suggests policy changes to encourage flexibility in academic eligibility requirements for enrollment in study abroad. The long-standing gap in the likelihood to participate in education abroad between male and female students is replicated in this study. This suggests the need to examine how each gender is socialized to enhance their educational experiences during college. Additionally, the findings of the first study inform the methodological matching process to balance education abroad and non-education abroad participants to reduce the selection bias for future research.

The purpose of the second and third studies is to examine the impact of participation in education abroad on college completion. To address the methodological challenges and limitations, both studies use propensity score matching (PSM) to reduce the selection bias—a threat to internal validity inherently existing within the nature of education abroad research—and to obtain samples of education abroad participants and non-participants who share a similar likelihood to participate in education abroad based on observed characteristics.

The second study used the findings from the first study to select a comparison group that shares similar likelihood to participate in education abroad to examine the effects of education abroad on graduation rates. Moreover, this study used PSM to explore how education duration and times of education abroad experiences impact graduation rates, which have not been studied in this way previously. Overall, education abroad participants were more likely to graduate within four years or six years. Students who studied abroad

for less than one semester or one semester were more likely to graduate within four years and six years than students who did not study abroad. For different numbers of education abroad experiences, the results indicate students who had one education abroad experience were more likely to graduate within four years and six years than students who had no education abroad experience and students who had more than one education abroad experience.

Using two national datasets that were collected across multiple institutions, the third study first examines the association between both student- and institution-level factors and students' likelihood to participate in education abroad. The findings of the first examination provide suggestions on what should be included in the PSM model in order to select a comparable untreated group to reduce the selection bias while assessing the effects of participation in education abroad on bachelor's degree attainment. This study is unique in its attention to the participation and effects of education abroad by including both student- and institution-level characteristics while adopting PSM to reduce the selection bias that has existed in education abroad research. First, the results of this study confirmed that education abroad as one of the high-impact practices that enhances student success, measured as bachelor's degree attainment. Second, by including a rich array of institutional-level variables from the IPEDS dataset, this study explores how various different institutional settings affect students' participation in education abroad. For example, students from private not-for-profit 4-year institutions are more likely to study abroad than students from public and private for-profit institutions. Students from highly selective institutions have the highest likelihood to participate in education abroad. Whether the institutions accept advanced credits from high school is also a statistically significant predictor of participation in education abroad.

KEYWORDS: Education Abroad, College Completion, Selection Bias, Propensity Score Matching, Equitable Access, High-Impact Activity

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UNDERSTAING EDUCATION ABROAD WITH ADVANCED QUANTITATIVE METHODOLOGIES: STUDENT PROFILES AND ACADEMIC OUTCOMES

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CHAPTER 1. OVERALL INTRODUCTION

1.1 Statement of Problem

Education abroad, often used interchangeably with the term study abroad, is broadly defined as "education that occurs outside the participant's home country. Besides study abroad, examples include such international experiences as work, volunteering, non-credit internships, and directed travel, as long as the programs are driven to a significant degree by learning goals" (Forum on Education Abroad, 2011, sect 2.1). Education abroad is hardly a new phenomenon. The U.S. tradition of education abroad is generally traced to professors at several late-nineteenth-century eastern colleges who conducted "groups of young ladies on education tours of Europe, visiting museums, cathedrals and the like" (Bowman, 1990, p. 13). In order to promote world peace and inspire students to learn more about the world outside of U.S. borders, two types of organized education abroad programs first emerged after World War I: Junior Year Abroad (JYA) and faculty-lead study tours, often on ships (Hoffa, 2007). Individual campus study abroad efforts received a major boost from the founding of the Institute of International Education (IIE) in 1919. The IIE quickly became involved in promoting internationalization in higher education by serving as a clearinghouse for curricular and practice information (Hoffa, 2007).

After World War II, accompanied by the increased attention to internationalization of higher education, education abroad experienced tremendous growth. During this period, education abroad took on added importance beyond its educational function (Twombly, Salisbury, Tumanut, & Klute, 2012). Mikhailova (2003) noted that students were ambassadors, representing the best national interests of American society and promoting

international understanding. Over time, policy makers shifted this motivation in response to the requirements and challenges related to the globalization of either economy, societies or labor markets (Van der Wender, 1997), as well as political and environmental issues (de Wit, 2002; Friedman, 2006).

Today, education abroad at institutions has taken on a life of its own. The purposes of education abroad for colleges and universities have become more salient. The entire U.S. higher education enterprise, from colleges and universities to higher education associations and organizations, as well as federal government and the business community, have promoted and encouraged education abroad as a strategy to accomplish their internationalization goals (Twombly et al., 2012). Moreover, education abroad is a tool through which students can build up capabilities to engage in global practices with broad knowledge and perspectives (Leobick, 2017; Altbach & Knight, 2007; Kernaghan, 2012), to build diverse understandings and connections between people worldwide (IIE, 2017), to enhance global competitiveness and international collaboration (Dwyer, 2004), to improve job opportunities and career readiness (Kernaghan, 2012), and to advance values of liberal education (Hovland, 2010).

The number of American students participating in education abroad continues to grow. Open Doors (Institute of International Education [IIE], 2019) reported that 341,751 American students received academic credit through education abroad in the 2017-18 academic year, an increase of 2.7% from the previous year. Student involvement in education abroad has grown steadily since the early 1990s, with nearly five times as many students participating during the academic year of 2017-18 as 1991-92 (IIE, 2019). However, the number is far behind the Commission on the Abraham Lincoln Study Abroad

Fellowship Program's 2005 goal to send one million students studying abroad annually by 2016-17. In addition, disparities in access to education abroad reveals a critical diversity and equity issue in higher education. For example, previous studies found that minority students have been underrepresented among study abroad participants for decades (Dessoff, 2006; Hembroff & Rusz, 1993). There has been a long-standing gap in education abroad between males and females. Males are less likely to participate in education abroad. About 70% of education abroad participants identify as white, despite the fact that white students only represent about 57% of the U.S higher education student population (Longmire-Avital, 2019). In addition, students from low-income families are less likely to participate in education abroad than students who are from higher-income families (Sutton & Rubin, 2010; Whatley, 2017).

To increase participation in education abroad and diversify education abroad participants, education abroad scholars and practitioners must understand education abroad student profiles and identify barriers that are associated with students' participation. Recent research has made important and insightful contributions to our understanding of factors affecting students' participation in education abroad. Nevertheless, there studies have limitations. None of the studies revealed a full profile of participation in education differentiated by colleges within one single institution. In addition, previous studies failed to describe how student-level factors interactively influence students' participation in education abroad.

As the profile of education abroad increases on campuses nationwide, calls for accountability have also been increasing. Some education abroad scholars have started to question whether the increased attention and efforts are warranted, and there is a growing

need to supply evidence of learning outcomes through more rigorous education abroad assessment and deeper research (Salisbury, 2011; Twombly et al., 2012). These questions were in particular raised in the environment of greater accountability from institutions of higher education where the "accreditation requires that the effectiveness of academic programs be assessed" (Savicki, Brewer, & Whalen, 2015, p. 1). Thus, the professional education abroad community has been implementing a series of initiatives supporting education abroad practitioners and researchers in conducting education abroad assessment in order to be part of this important academic conversation, including IIE, the Forum on Education Abroad, Comparative and International Education Society (CIES), and NAFSA: Association of International Educators have called to develop its own assessment (Hoffa, 2005). In response to these needs, several multi-institutional studies (Vande Berg, Balkcum, Scheid, & Whalen, 2004; Vande Berg, Connor-Linton, & Paige, 2009; Salisbury, Umbach, Paulsen, & Pascarella, 2009; Sutton & Rubin, 2004) and many qualitative inquiries into a single program or small sample groups of students (Carlson & Widaman, 1988; Kitsantas & Meyers, 2001; Braskamp, Braskamp, & Merrill, 2009) have sought to provide empirical evidence and demonstrate the benefits of participation in education abroad.

1.2 Methodological Limitations

Although the previous studies have called attention to a growing need for education abroad assessment and provided a better understanding of the impact of education abroad in different domains, rigorous and well-designed studies are still needed. In addition, much of the existing education abroad research has been undermined by methodological and

design shortcomings, such as selection bias, generalizability, lack of institutional and college level characteristics, and inattention to the variation across different education abroad programs.

1.2.1 Selection Bias

Using experimental methods to assess the education abroad outcomes would be ideal because it tends to produce unbiased estimates (Deardorff, 2009; Steinberg, 2007). However, education abroad is a self-elective activity. Moreover, it is unusual for institutions to assign students randomly to participate or not participate because of the highly variable location of education abroad within the curriculum and the structure of academic majors and financial aid systems. Previous studies have shown that many factors could affect students' intent to participate, or not to participate, in education abroad (Booker, 2001; Carroll, 1996). For decades, enrollment in education abroad has been and continues to be largely restricted to white, affluent, middle or upper-class female students (Booker, 2001). Additionally, students who were exposed to international travel opportunities previously are more likely to participate in education abroad (Cole, 1991). Williams (2005) found that education abroad participants have higher levels of intercultural communication skills. The issue of self-selection within the education abroad context, therefore, calls for a research design that takes into consideration not only the need to obtain a truly comparable group, but also statistical techniques that can reduce the effect of selection bias. Obtaining comparison groups is a common approach to assess the effect of education abroad (Engle & Engle, 2004). However, selecting a comparison group that could share the similar likelihood to participate in education abroad with the treatment group at the baseline is a key step for education abroad assessment research.

1.2.2 Generalizability

Existing research in the field of education abroad has predominately been institution specific and small scale (Ogden & Streitwieser, 2016), which are potential threats to the external validity or generalizability. Research results generated from a single institution setting cannot be broadly generalizable to the field of US education abroad. On the contrary, the findings can only be applied to institutions who share similar characteristics in terms of institution type, institutional education abroad policy, education abroad program settings, financial structure, etc. Therefore, there is arguably a case for theoretical generalizability without data across different types of institutions.

1.2.3 Lack of Institutional and College Level Data

Although much of the education abroad research is institution specific, there has been a trend to collect data across institutions and to organize and make large datasets publicly available. Three large scale education abroad projects are known to be multi institutional: The Georgetown University Consortium Project (Vande Berg, Balkcum, Scheid, & Whalen, 2004; Vande Berg, Connor-Linton, & Paige, 2009), the Wabash National Study on Liberal Arts Education (WNSLAE) (Salisbury, Umbach, Paulsen, & Pascarella, 2009), and the Georgia Learning Outcomes of Students Studying Abroad Research Initiative (GLOSSARI) project (Sutton & Rubin, 2004). Salisbury et al. (2009) added institutional type as a confounding variable to the single level multiple regression analysis to predict education abroad participation. The other two studies did not account for any institutional-level characteristics that could potentially affect the outcome assessment, for example, the institutional type, tuition and financial structures, institutional

policy, etc. In addition, the education abroad opportunities and program flexibility that each individual college can provide to their students vary, for example students from a college of fine arts may have more access to education abroad programs than those from a college of engineering.

1.2.4 Inattention to the Variation of Education Abroad Programs

Some of the datasets that education abroad research has used were not initially designed for the purpose of education abroad research. The main independent variable for participation in education abroad is often indicated as a binary categorical variable: either participation in study abroad "1," or non-participation "0." It consequently limits the depth and type of analysis (Stroud, 2010), as the length and purposes of each education abroad program are different. Without taking the variance of each education abroad program into consideration, researchers fail to get a robust estimate effect of education abroad on learning outcomes due to the threat to the internal validity of the studies.

1.2.5 Others

Besides these four major challenges, sample size and data accessibility are also issues for research on study abroad. Chieffo and Griffiths (2004) pointed out that much of the education abroad outcomes assessment research is small-scale, thus barely able to account for changes that are statistically significant. Most of the self-collected institutional education abroad data, or even the Open Doors data collected by Institute for International Education (IIE), are basically enrollment data. This type of data is not linked to other databases of student demographics and achievement for more complex statistical analyses or computations (Ogden & Streitwieser, 2016).

Overall, education abroad has come to play a more important role in undergraduate education and the number of students participating in education abroad has rapidly increased. As a consequence, there has been a substantial growth in education abroad research to supply evidence of the unique benefits of participation in education abroad. However, compared with scholarly studies in other areas of higher education, there still remains a shortage of critical and systematic research in the field of education abroad. As a result, many institutions are still struggling to provide robust evidence of the value that an education abroad program adds to an undergraduate education.

1.3 Purposes of the Dissertation

Three distinct manuscripts of the following titles comprise this dissertation:

- Who studies abroad at a four-year public university? Analyses with classification and regression tree and logistic regression
- Assessing the impact of education abroad on student success in a four-year public institution
- Using a national longitudinal study to understand the participation and effects of education abroad

This three-study dissertation aims to contribute to the research in the field of education abroad, particularly as it relates to student profiles and academic outcomes. understanding the factors associated with students' participation in education abroad and the effects of education abroad on college completion. Through employing more robust methodologies across the three studies, this dissertation aims not only to understand what are the factors associated with education abroad participation and how these factors interplay with each

other, but also to provide a less biased picture of the impact of participation in education abroad on postsecondary educational outcomes (See Table 1 for an overview of the three studies).

The first study in this dissertation begins with the question: who studies abroad? Utilizing logistic regression and classification and regression tree, the first study examines the average effect of each independent variable on the likelihood of education abroad participation, and also captures the complex interactive effects among independent variables and present the effects in an intuitive way. The findings of this study provide implications for education abroad policy makers and practitioners to understand student level barriers to education abroad participation, which helps them develop strategic policies and programs to ensure and promote an equitable and inclusive access to education abroad. Additionally, the findings of the first study inform the methodological matching process to balance education abroad and non-education abroad participants to reduce the selection bias for the second study.

The purpose of the second and third studies is to examine the impact of participation in education abroad on college completion. To address the methodological challenges and limitations, both studies use propensity score matching (PSM) to reduce the selection bias—a threat to internal validity inherently existing within the nature of education abroad research—and to obtain samples of education abroad participants and non-participants who share a similar likelihood to participate in education abroad based on observed characteristics.

The second study used PSM used the findings from the first study to select a comparison group that shares similar likelihood to participate in education abroad to

examine the effects of education abroad on graduation rates. Moreover, this study used PSM to explore how education duration and times of education abroad experiences impact graduation rates, which have not been studied in this way previously.

Using two national datasets that were collected across multiple institutions, the third study first attempts to examine the association between both student- and institution-level factors and students' likelihood to participate in education abroad. The findings of the first attempt provide suggestions on what should be included in the PSM model to in order to select a comparable untreated group to reduce the selection bias while assessing the effects of participation in education abroad on bachelor's degree attainment. This study is unique in its attention to the participation and effects of education abroad by including both student- and institution-level characteristics while adopting PSM to reduce the selection bias that has existed in education abroad research.

Table 1.1 (continued) Overview of the Tree Manuscripts

	Paper 1	Paper 2	Paper 3
Title	Who studies abroad at a four-year public university? Analyses with classification and regression tree and logistic regression	Assessing the impact of education abroad on student success in a four-year public institution	Using a national longitudinal study to understand the participation and effects of education abroad
Research questions	-What are student-level factors that predict students' participation in education abroad? -How does participation vary from college to college? -What are the interactive effects of these factors on students' participation in education abroad?	-What are the effects of participation in education abroad on students' 4-year and 6-year graduation rates in a four-year public institution? -How does the duration of education abroad impact students' 4-year and 6-year graduation rates in a four-year public institution? -How does the number of education abroad experiences impact students' 4-year and 6-year graduation rates in a four-year public universities?	-What are both student-level and institution-level factors that predict students' participation in education abroad? -What are the effects of participation in education abroad on bachelor's degree attainment?
Methods	-Logistic regression -Classification and regression tree	-Propensity score matching -Logistic regression -Fixed effect	-Propensity score matching -Logistic regression

Data	-A dataset collected from a four-year public university	- The same dataset used in study 1	U.S. national datasets -ELS:2002 -IPEDS
Dependent variable(s)	-Participation in education abroad	-4-year graduation rate -6-year graduation rate	-Bachelor's degree attainment
Independent variables	URM; Gender; First-generation; first-year foreign language; first-year Pell Grant; First-year GPA; college readiness; advanced hours accepted; college; cohort year.	Education abroad participation; duration of education abroad; number of education abroad experiences; URM; Gender; First-generation; first-year foreign language; first-year Pell Grant; First-year GPA; college readiness; advanced hours accepted; college; cohort year.	***Student-level variables:*** Education abroad; gender, URM; socio-economic status; high school GPA ***Institution-level variables:*** Institution type; institution selectivity; historically black college or university; education abroad programs; accepting advanced credits; providing remedial services; providing employment services.

CHAPTER 2. WHO STUDIES ABRAOD AT A FOUR-YEAR PUBLIC UNIVERSITY? ANALYSES WITH CLASSIFICATION AND REGRESSION TREES AND LOGISTIC REGRESSION

2.1 Introduction

The number of American students participating in education abroad continues to grow. Open Doors (Institute of International Education [IIE], 2019) reported that 341,751 American students received academic credit through education abroad in the 2017-18 academic year, an increase of 2.7% from the previous year. Student involvement in education abroad has grown steadily since the early 1990s, with nearly five times as many students participating during the academic year of 2017-18 as 1991-92. Despite the steady increase in education abroad participation, disparities in participation reveals a critical diversity and equity issue in higher education. Minority students have been underrepresented among study abroad participants for decades (Dessoff, 2006; Hembroff & Rusz, 1993). About 70% education abroad participants identify as white, despite the fact that white students only represent about 57% of the U.S higher education student population (Longmire-Avital, 2019). In addition, students from low-income families are less likely to participate in education abroad than students who are from higher-income families (Sutton & Rubin, 2010; Whatley, 2017). Increasing access to education abroad opportunities to all student population on campus has been a goal for many education abroad offices nationwide. Without a commitment to diversity, the oft-stated goals of education abroad - cultural understanding and world peace -- will never be achieved (Hulstrand, 2016). Thus, providing adequate support tailored to the needs of students who are underrepresented among education abroad participants is of prime importance.

To help promote an equitable access to education abroad and diversify education abroad participants, it is critical for higher education institutions and organizations, to understand the factors that are associated with their students' participation in education abroad. Most recent research has made important and insightful contributions to our understanding of factors affecting students' participation in education abroad. Nevertheless, these studies have limitations. None of the studies revealed a full profile of participation in education across different colleges within one single institution. In addition, previous studies failed to identify the importance of factors that predict students' participation in education abroad and to describe how these factors interactively influence students' participation in education abroad.

Using administrative data across two cohorts in a four-year public university, this study seeks to build on previous research and examine the factors associated with students' participation in education abroad. In order to address previous methodological limitations, this study used both logistic regression analysis and classification and regression tree (CART) analysis. Logistic regression examined the average effects of each factor on the likelihood to study abroad, and CART captures the complex effects among these factors. By reconciling the results from both analyses, this study aims to provide a nuanced understanding of characteristics and backgrounds of study abroad participants in comparison to their non-participating peers, to identify what factors are more likely to promote students' participation in education abroad, and to understand how these factors interactively affect student's participation in education abroad.

2.2 Literature Review

2.2.1 Demographics

In terms of demographic characteristics, researchers have found female and white students to be more likely to participate in education abroad than their male and minority counterparts (Salisbury, Paulsen, & Pascarella, 2010, 2011; Dessoff, 2006; Stroud, 2010; Simon & Ainsworth, 2012). Studies have also indicated that low socioeconomic status of a student's family served as barrier to participate in education abroad (Booker, 2001; Simon & Ainsworth, 2012). Booker (2001) noted that study abroad participants were less likely to be reliant on financial aid and/or employment to attend college. Simon and Ainsworth (2012) measured the socioeconomic status from three areas: parents' education, parents' occupational prestige, and parents' income. They found that all three measures were positive and statistically significant predictors of study abroad participation (Simon & Ainsworth, 2012). Findings of previous studies also indicated that student loans and financial need negatively influenced the likelihood of a student participating in education abroad (Sutton & Rubin, 2010; Whatley, 2017).

2.2.2 Academic factors

A series of academic factors also appear to influence students' education abroad attitudes and decisions. Researchers found that students with higher academic performance, measured as college grade point average (GPA), Scholastic Assessment Test (SAT), or American College Testing (ACT), were more likely to participate in education abroad (Paus & Robinson, 2008; Luo & Jamieson-Drake, 2015; Salisbury et al., 2010, 2011; Thomas & McMahon, 1998). Some scholars suggested that proficiency in a foreign language predicted participation in study abroad (DuFon & Churchill, 2006). In addition, studies (Luo & Jamieson-Drake, 2015; Obst, Bhandari,

& Witherell, 2017; Salisbury et al., 2010, 2011; Hauschildt, Gwosc, & Mishra, 2016) indicated that students from certain academic fields were more likely to have positive attitudes toward education abroad and to participate in such experiences than their peers in other fields. For example, Salisbury et al. (2010) found that, compared with students in the arts and humanities, students in the social sciences were 10 percentage points more likely to express an intent to study abroad. Prior studies suggested that lack of curricular flexibility could be a critical reason why students in STEM majors were less likely to participate in education abroad (Carlson, Burn, & Yachimowicz, 1990; Twombly et al., 2012). Yet in another study, Rust, Dhanatya, Furuto, and Kheiltash (2008) indicated that the freshmen planning to major in mathematics, engineering and the physical sciences were just as interested in education abroad as those in the humanities and social sciences.

2.2.3 Attitudes and interests

Studies also noted that the differences in attitudes, interests, affective traits, and certain behaviors could influence students' decisions and attitudes toward education abroad (Rust et al., 2008; Salisbury et al., 2009; Simon & Ainsworth, 20012; Stroud, 2010; Goldstein & Kim, 2006; Carlson, Burn, & Yachimowicz, 1990). Luo and Jamieson-Drake (2015) found that students intending to study abroad had higher education abroad participation rates than those who did not intend to. Goldstein and Kim (2006) concluded that compared to non-participants, education abroad participants were less ethnocentric, less racially biased, and more interested in learning a foreign language. Carson et al. (1990) found that, in comparison to non-participants, education abroad participants were more critical of American foreign policy, more optimistic about the quality of postsecondary education in western European countries, and more interested in experiencing other cultures prior to their departure.

2.2.4 Other factors

Other potential barriers to participation in study abroad have also been examined. Carlson et al. (1990) found that education abroad participants tended to have traveled abroad previously. Much of the literature cited a lack of information and awareness of education abroad programs as a barrier for students to participate (Brux & Fry, 2010; Dessoff, 2006). Additionally, the type of institutions students attended also appeared to influence their decisions on participation in education abroad. Salisbury et al. (2009) found that students attending community colleges and regional comprehensive and research institutions were less likely to intend to study abroad than students at liberal arts colleges.

2.3 Methodological limitations

The literature suggests that a host of variables is associated with students' participation in education abroad. However, all of the previous studies basically relied on two analytic approaches to explore and understand the factors that affect students' participation in education abroad. The first approach estimates the percentage of the education abroad participants among strata of categorical variables or compares the mean values of continuous variables between education abroad or non-education abroad participants. Although this approach is useful in providing descriptive statistics on students' participation in education abroad, it fails to make predictions to examine the relationship between an outcome measure and explanatory measures. The second approach uses binary logistic regression to handle analyses with a dichotomous dependent variable (Hosmer & Lemeshow, 2000). Within the field of education abroad research, binary logistic regression is used to examine the relationship between independent measures and participation in education abroad. Logistic regression models determine the average effect of an independent

variable on a dependent variable, without consideration of special needs of population subgroups. Although logistic regression models allow for the testing of statistical interactions among independent variables, the results can be difficult to interpret, particularly when an interaction term includes three or more variables at a time. Both approaches have limitations in their capabilities to segment a data sample into distinct subgroups whose members share common characteristics that influence participation in education abroad.

Classification and regression tree (CART), known as an effective nonparametric exploratory statistical technique, is a heuristic tree method that unpacks the relationship between an outcome measure and a group of predictors (Breiman, Friedman, Olshen, & Stone, 1984). The CART analysis has two main parts: classification tree (CT) and regression tree (RT), depending on the nature of the outcome variables. CT is used for categorical outcome variables, while RT is for continuous variables (De'ath & Fabricius, 2000). This study used CART as a general expression. CART is a host of advanced statistical methods that statistically cluster individuals into a number of mutually exclusive and exhaustive groups with markedly different outcome measures, based on the interaction effects among explanatory variables (Ma, 2018). The statistical principle of CART can be summarized as recursive partitioning, that is, "progressively dividing individuals into smaller and smaller groups with increasing similarities in the dependent variable within each group and meanwhile with increasing differences in the dependent variable measure between newly formed groups" (Ma, 2018, p.12).

Compared with traditional statistical techniques, such as binary logistic regression, CART has several advantages (Breiman, Friedman, Olshen, & Stone, 1984). Most of the traditional statistical techniques examine the relationship between dependent and independent variables through building up statistical models. Typically, it is difficult to identify and model the complex

interactive effects among independent variables, especially when there are a large number of them. In comparison, CART can capture the complex interactive effects of significant independent variables. CART does not involve any mathematical equations. Thus, its results are easy to interpret and understand. Moreover, CART is a nonparametric statistical technique that is free from some distributional assumptions, such as normal distribution. In addition, some recent CART applications have shown that the results of CART can guide and inform modeling to improve overall performance of traditional statistical techniques (Srivastava, 2013).

CART is largely known in the field of medical research, but to a much less extent, in education research (Lemon, Roy, Friedmann, & Rakowski, 2003). However, many research questions in education can be better investigated and addressed using this technique, especially when it examines the interaction effects among independent variables. This technique holds great potential for researchers to explore and understand factors that are associated with college students' participation in education. This study adopted CART to (a) explore the importance of variables that predicted students' participation in education abroad, (b) identify the characteristics of students who were more/less likely to participate in education abroad, and (c) describe how students' characteristics interactively influence their participation in education abroad. In addition, this study also adopted logistic regression analysis to understand the relationship between students' characteristics and their participation in education abroad. This statistical practice, referred to as statistical triangulation (Cohen & Manion, 2000), reconciles the differences of results from both methods in order to make a credible knowledge claim by examining the same data at hand.

2.4 Purpose of the Study

The purpose and goal of this study is to understand the education abroad profile and provide research-based evidence for education abroad practitioners to develop strategic policies and programs to promote broader student access and inclusion. By addressing the current methodological limitation in the previous studies, I undertook this study to explore the factors that were associated with students' participation at a 4-year public institution by answering the following research questions:

- What are student-level factors that predict students' participation in education abroad?
- How does participation in education abroad vary from college to college?
- What are the interactive effects of these factors on students' participation in education abroad?

2.5 Method

2.5.1 Data

The data for this study focuses on two cohorts of undergraduates at one large 4-year public research university in the mid-east combining information from multiple sources. Specific data sources include: (1) institutional records capturing students' background characteristics and their academic pathways; and (2) data tracking education abroad participation. Institution records included students who matriculated to the university for the first time and full time during the cohort years of Fall 2010 and 2011 (n=8,250). This longitudinal institutional dataset includes a rich array of high school and postsecondary variables, allowing me to track individual students from high school to postsecondary educational institution. The institutional records were matched

with educational abroad data via a unique student identifier. The education abroad data provided a detailed list of information relevant to education abroad participation over the entire course of students' college career, such as length of education abroad, education abroad destination, etc.

2.5.2 Measures

The outcome of interest in this study is education abroad participation. I categorized this outcome variable as a binary variable, indicating whether students even participated in any education abroad program in college. I selected the independent variables based on prior literature on factors associated with education abroad participation. Previous studies found that female and white students were more likely to participate in education abroad than their male and minority counterparts (Salisbury, Paulsen, & Pascarella, 2010, 2011; Dessoff, 2006; Stroud, 2010; Simon & Ainsworth, 2012). I included a binary variable representing gender and combined racial and ethnic groups into a binary variable, indicating underrepresented minority (URM). As to the socio-economic factors that were found to be associated with students' participation in education abroad (Booker, 2001; Simon &Ainsworth, 2012), I used first-generation as a binary variable based on their parents' or legal guardian's highest educational attainment: (a) neither parent has completed a baccalaureate degree or (b) at least one parent has completed a baccalaureate degree. I also included whether a student received a Pell grant during their first year of college as a binary variable to represent students' family financial background.

Previous studies found that students with higher academic performance were more likely to participate in education abroad. I used college readiness as a continuous variable to represent students' prior academic background before education abroad (Paus & Robinson, 2008; Luo & Jamieson-Drake, 2015. This variable is a specific index used by the institution for determining

admission or rank to indicate students' pre-college readiness. The institution used the results of the two-variable logistic regression to create the index. This index used an arbitrary scaling to convert the coefficients from the logistic regression fit to bound, readily understandable numbers: $college\ admission\ index = 10 \times high\ school\ GPA + \frac{ACT}{2}$. I also included first-year GPA in college as a continuous variable to represent students' academic performance. This variable is a measure of average academic performance in all courses taken by a student during the first year of college, operated on a scale of 0 to 4. Some scholars found that proficiency in a foreign language and high levels of foreign language interests predicted participation in study abroad (DuFon & Churchill, 2006; Goldstein & Kim, 2006). I created a binary variable—first-year foreign language experience—to indicate students' foreign language interests. This variable indicates whether a student took a foreign language course during their first year in college.

A couple studies found that students from certain academic fields were more likely to have positive attitudes toward education abroad and to participate in such experiences than their peers in other fields (Carlson, Burn, & Yachimowicz, 1990; Twombly et al., 2012). I included college as a categorical variable to indicate the college in which students were studying during their first year at the university. There were 14 categories in total for college, including a category that contained students who did not decide their major during their first year of college. Additionally, I split students from College of Arts and Sciences into two separate categories: Arts and Sciences. I considered the advanced standing hours accepted by the university as factor that may increase the likelihood of studying abroad. There have been concerns that education abroad impedes timely graduation. Having advanced standing hours accepted by the university, students might not be concerned by the time spent in education abroad overseas. I included this variable as a continuous one, which indicates the number of credit hours accepted from Advanced Placement, International

Baccalaureate, Dual Enrollment, and other evaluated programs prior to a student's matriculation to the institution.

2.5.3 Analytic Strategies

2.5.3.1 Logistic Regression Analysis

Binary logistic regression is a predictive analysis to examine the relationship between independent variables and one dichotomous dependent variable. The relationship can be represented as a logistic function (Cleary & Angel, 1984). The logistic function can be expressed in the following mathematical form:

$$p(x) = \frac{e^{\beta_0+\beta x}}{1+e^{\beta_0+\beta x}} = \frac{1}{1+e^{-(\beta_0+\beta x)}}$$

Where $p(x)$ is the conditional probability of an event $(Y = 1)$ occurs as a function of x. Mathematically, any unknown parameters in the function are to be estimated by maximum likelihood (Healy, 2006).

The ratio of the probability of an event $(Y = 1)$ occurs to the probability of an event $(Y = 0)$ occurs: $\frac{p}{1-p}$ is called the odds ratio. In this study, the odds ratio represents the change in the odds of participating in education abroad relative to not participating in education abroad that is associated with a one-unit change in a particular independent variable while holding constant all other variables. An odds ratio greater than one represents that an increase in the likelihood of participating in education abroad is associated with one unit increase in the dependent variable, whereas an odds ratio less than one represents that a decrease in the likelihood of participating in education abroad is associated with one unit increase in the independent variable.

Additionally, I included college and cohort fixed effects in the logistic regression models. The fixed effects models are often used when the primary goal of analyzing clustered longitudinal data is to explore a relationship over time between predictors and outcome variable within a given group. For this study, the data sample included students from multiple colleges and across two cohorts within a single institution. Thus, there are variations in education abroad participation across colleges and cohorts. Students from the same college might share some similar unobserved characteristics that are associated with the likelihood of studying abroad. As a result, this may bias the estimated relationship between students' observed characteristics and participation in education abroad. By including college fixed effects, the shared unobserved students' characteristics within each college are removed from the estimation. It is also necessary to account for unobserved variation in education abroad participation across cohorts. By including cohort fixed effects, any variation occurring between cohort years can be absorbed. Including both college and cohort fixed effects allows for the interpretation of results as within-college and within-cohort estimates.

I followed step-by-step process to build up three models that estimated the relationship between all eight predictive variables and participation in education abroad. For model 1, eight predictive variables were included. I added cohort fixed effects to model 1 to construct model 2. Model 3 included college fixed effects as the final model. For all logistic regression results, both odds ratio and marginal effects at the means (MEM) were calculated and recorded. Compared with the odds ratio, the MEM presents the differences in probabilities while holding other confounding variables at their means. Therefore, MEM can provide a clearer interpretation of the magnitude of the relationship between the dependent variable and each of the independent variables by isolating these outcomes variables without effect from the other factors. Adjusted predictions at the means

(APM) were also computed and reported to present the average predicted probabilities while holding other confounding variables at their means. All logistic regression analyses were conducted using Stata SE/14.0 statistical software.

2.5.3.2 CART Analysis

For this study, CART is a machine learning tool to identify the factors that are associated with students' participation in education abroad and to unearth ways that students' characteristics interactively affect students' likelihood to participate in education abroad. Breiman, Friedman, Olshen, and Stone (1984) first introduced the theoretical foundations and practical applications of CART. Statistically, CART performs successive binary splitting of groups at each level while growing a tree. Starting from the root node – in other words, the entire student sample – CART examines each explanatory variable for how well it splits every parent node into two child nodes. The splitting process is guided not by any statistical test, but by a statistical measure called impurity (Breiman et al., 1984). Impurity measures the degree to which students in a node vary in outcome measure. The explanatory variable that yields the largest reduction in impurity is selected to perform the first split. Through the recursive tree-growing process, students are split into smaller and smaller nodes. Along with the splitting process, cases share more and more similarities in outcome measure within each node, as well as more and more differences in outcome measure between nodes. Nodes that cannot be split are called terminal nodes.

The impurity measure used in this study is the Gini measure of dispersion (Breiman et al., 1984):

$$i(\tau) = 1 - \sum P(c_j)^2$$

Where $P(c_j)$ represents the probability that a case being classified to the category c_j of an exploratory variable in node τ. The degree of Gini index varies between 0 and 1, where 0 denotes that all cases belong to one category of an exploratory variable, and 1 denotes that the cases are randomly distributed across different categories of the exploratory variable. The smaller the Gini index is, the less impure the node is.

The challenge to use the guideline of reduction in impurity is to grow a tree big enough to discover the relationship in the data, while preventing the tree from growing too large. To deal with this challenge, an approach – often called pruning the CART tree – grows a tree until the minimum impurity standard is met everywhere in the tree and then prunes the tree by combining nodes on the basis of reduction in impurity (Duda, Hart, & Stork, 2001). Additionally, the fundamental principle underlying CART is simplicity: "partitions that lead to a simple, compact tree with few nodes" (Duda et al., 2001, p. 398). In order to assist this process of growing a CART tree, for this study I used a node of 100 cases as the minimum size of a parent node and a node of 50 cases as the minimum size of a child node. I set up the analysis to allow the CART to grow to five levels. These strategies aim to help develop a CART tree that is parsimonious and meaningful. All CART analyses in this study were run with SPSS Decision Trees.

In addition, for both CART and logistic regression, receiver operating characteristics (ROC) analysis was constructed as a measure to assess the overall accuracy of model classification on the simultaneous measure of sensitivity (true positive) and specificity (true negative). The area under the ROC curve range from 0.5 to 1.0 with larger values indicative of better fit. Both methodologies have their own advantages and disadvantages. It is important to adopt both of them to understand the factors that are associated with students' participation in education abroad. Logistic regression was able to examine the average effect of each independent variable on the

likelihood to participate in education abroad, while CART was able to capture the complex interactive effects among independent variables and present the effects in an intuitive way. This statistical practice aims to make a credible claim by reconciling the differences of results from both methods.

2.6 Results

2.6.1 Descriptive Statistics

I first explored the differences that existed in all eight independent variables included in the analyses of the study between students who participated in education abroad and students who did not. Table 1 illustrates the findings.

Among the full sample, education abroad participates were less likely to be male (30.54%) and more likely to be underrepresented minority (15.71%) than non-education abroad participants (Male: 49.87%; URM: 12.43%). Compared with students who did not participate in education abroad (First-generation: 19.13%; Pell: 25.19%), education abroad participates were less likely to be first-generation students (12.29%) or to receive a Pell Grant during the first year of college (17.85%). Students who studied abroad were more likely to have studied a foreign language (14.05%) during the first year of college, in comparison to students who did not study abroad (6.45%).

In terms of college readiness, as measured by college admission index, students who participated in education abroad had an average mean score of 50.69, with a standard deviation of 6.10, which was 2.18 score points higher than students who didn't participate in education abroad ($M = 48.51$, $SD = 6.21$). On average, the first-year GPA of students who participated in education

abroad obtained was 3.36, with a standard deviation of 0.56, which was 0.53 points higher than students who did not participate in education abroad (M = 2.83, SD = 0.94). As to

the number of credit hours accepted from high school prior to a student's matriculation to the institution, the mean of credit hours accepted for education abroad participates was 7.59, with a standard deviation of 11.21, which was 3.03 credit hours higher than non-education abroad participants (M = 4.56, SD = 8.82).

Table 2.1 Descriptive Comparison of Education abroad (EA) and Non-Education Abroad (non-EA) Participants Across Independent variables

Independent Variables	Total Sample	EA	Non-EA	Difference
URM	12.84%	15.71%	12.43%	3.28**
Male	47.47%	30.54%	49.87%	-19.33***
First-generation	18.28%	12.29%	19.13%	-6.84***
First-year foreign language experience	7.39%	14.05%	6.45%	7.60***
First-year Pell Grant	24.28%	17.85%	25.19%	-7.34***
First-year GPA	2.90 (0.92)	3.36 (0.56)	2.83(0.94)	0.53***
College readiness	48.78 (6.21)	50.69 (6.10)	48.51 (6.21)	2.18***
Advanced hours accepted	4.94 (0.10)	7.59 (11.21)	4.56 (8.82)	3.03***
Observations	8,250	1,025	7,225	

Note. For categorical independent variables, proportions were reported. For continuous independent variables, means and standard deviations were reported. Two-sample proportion tests were conducted for categorical independent variables. Two-sample t-tests were conducted for continuous independent variables. The differences were reported in percentage points for categorical variables.

*P ≤ .05. **P ≤ .01. ***P ≤ .001.

In addition, two-sample proportion tests and two-sample t-tests were conducted, respectively, for categorical and continuous independent variables. All the differences in all eight independent variables between education abroad and non-education abroad participates were found to be statistically significant, as indicated in Table 1.

Table 2 provides a descriptive comparison of education abroad and non-education abroad participants across two cohorts and fourteen colleges (The fourteenth category – "undecided" – includes students who had not claimed a major by the beginning of their second year of college). The descriptive statistics demonstrate that variation in education abroad participation across both cohorts and colleges existed. Compared with students of cohort 2010, students of cohort 2011 were more likely to participate in education abroad. In addition, the differences between percentages of education abroad and non-education abroad participants across colleges revealed that education abroad participants more likely to be students from the following seven colleges:

- College of Agriculture, Food, and Environment (EA: 11.02%; Non-EA: 8.69%),
- College of Communication (EA: 8.49%; Non-EA: 4.75%),
- College of Social Work (EA: 0.97%; Non-EA: 0.53%),
- College of Design (EA: 1.37%; Non-EA: 0.35%),
- College of Fine Arts (EA: 11.02%; Non-EA: 8.69%),
- College of Business and Economics (EA: 15.50%; Non-EA: 13.56%), and
- College of Arts and Sciences – Art (EA: 20.49%; Non-EA: 10.85%)

Table 2.2 (continued) Descriptive Comparison of EA and non-EA Participants Across Cohorts and Colleges

	Total Sample	EA	Non-EA	Difference
Cohort				
2010	51.28%	49.07%	51.60%	-2.53
2011	48.72%	50.93%	48.40%	2.53
Colleges				
College of Agriculture, Food, and Environment	8.98%	11.02%	8.69%	2.33*
College of Communication	5.21%	8.49%	4.75%	3.74***
College of Engineering	14.44%	9.27%	15.17%	-5.90***
College of Education	8.06%	6.54%	8.28%	-1.74
College of Social Work	0.58%	0.97%	0.53%	0.44
College of Design	0.47%	1.37%	0.35%	1.02***
College of Fine Arts	1.59%	2.63%	1.44%	1.19**
College of Health Sciences	1.47%	1.37%	1.48%	-0.11
College of Public Health	0.04%	0.00%	00.04%	-0.04
College of Nursing	5.93%	3.02%	6.34%	-3.32***
College of Business and Economics	13.84%	15.80%	13.56%	2.24
College of Arts and Sciences – Arts	12.05%	20.49%	10.85%	9.64***
College of Arts and Sciences – Sciences	13.95%	12.98%	14.09%	1.11

Undecided college	13.39%	6.05%	14.44%	8.39***

Note. The differences were reported in the unit of percentage points for categorical variables. Two-sample proportion tests were conducted.

*P ≤ .05. **P ≤ .01. ***P ≤ .005

2.6.2 Logistic Regression Analysis

Table 3 provides an overview on the effects of all the independent variables on participation in education abroad across model 1 through 3, as reported by both odds ratio and marginal effects at means. Table 4 provides the average predicted probabilities of participating in education abroad across sub-groups from Model 3. Seven out of eight independent variables included in the logistic regression model were found to be statistically significant predictors of students' participation in education abroad. Model 3 with both cohort and college fixed effects was found to be the best model overall with the largest pseudo R^2 and log-likelihood, and the smallest AIC and BIC. The following results of logistic regression analyses were based on model 3, as indicated in Table 3 and Table 4.

On average, a male student was 0.510 times as likely to participate in education abroad as a female student, controlling for all the other independent variables. The probabilities of participating in education abroad for a male and female student were 6.4% and 11.8% respectively. With all else equal, an URM student was 1.963 times as likely to participate in education abroad as a non-URM student. Holding all the other independent variables at their means, the probability of participating in education abroad for an URM student was 14.9%, while the probability for a non-URM student was 8.2%. A first-generation student was 0.737 times as likely to participate in education abroad as a non-first-generation student. On average, a first-generation student had a 7.1% chance of participating in education abroad, while an otherwise-comparable non-first-generation student had a 9.3% chance.

Whether a student had taken at least one foreign language class during their first year of college had a positive effect on participation in education abroad. On average, a student who had at least one foreign language class were 1.910 times as likely to participate in education abroad

Table 2.3 (continued) Logistic Regression Analysis of Estimates of Odds Ratio (OR) and Marginal Effects at Means (MEM) for Predicting Participation in Education Abroad

Independent Variables	Model 1		Model 2		Model 3	
	OR	MEM	OR	MEM	OR	MEM
URM	2.005***	0.059***	2.020***	0.059***	1.963***	0.055***
	(0.207)	(0.009)	(0.209)	(0.009)	(0.206)	(0.008)
Male	0.510***	-0.057***	0.510***	-0.057***	0.509***	-0.055***
	(0.038)	(0.006)	(0.038)	(0.007)	(0.041)	(0.007)
First-generation	0.728**	-0.027**	0.726**	-0.027**	0.737**	-0.025**
	(0.078)	(0.009)	(0.078)	(0.009)	(0.080)	(0.009)
First-year foreign language experience	2.260***	0.069***	2.272***	0.069***	1.910***	0.052***
	(0.244)	(0.009)	(0.246)	(0.009)	(0.222)	(0.009)
First-year Pell Grant	0.772**	-0.022**	0.770**	-0.022**	0.772**	-0.021**
	(0.073)	(0.008)	(0.073)	(0.008)	(0.074)	(0.008)
First-year GPA	2.433***	0.075***	2.432***	0.075***	2.295***	0.067***
	(0.175)	(0.005)	(0.175)	(0.005)	(0.171)	(0.005)
College readiness	0.996	-0.0003	0.996	-0.0003	1.005	0.0003
	(0.008)	(0.0007)	(0.008)	(0.0007)	(0.008)	(0.0007)
Advanced hours accepted	1.012**	0.001 **	1.011**	0.001**	1.011**	0.001**
	(0.004)	(0.0003)	(0.004)	(0.0003)	(0.004)	(0.0003)

Cohort fixed effects	NO	YES	YES
College fixed effects	NO	NO	YES
Observations	8,250	8,225	8,222
Pseudo R^2	0.0958	0.0962	0.1164
Log-likelihood	-2792.972	-2791.850	-2728.936
AIC	5603.944	5603.700	5501.872
BIC	5667.079	5673.850	5656.193

Note. Robust standard errors are in parentheses.

*P ≤ .05. **P ≤ .01. ***P ≤ .001.

Table 2.4 (continued) Average Predicted Probabilities of Participating in Education Abroad across Sub-groups from Model 3

Sub-group	Participation in EA	[1]SE	95% [2]CI
Gender			
Female	0.118	0.006	[0.107, 0.130]
Male	0.064	0.004	[0.056, 0.072]
URM			
Yes	0.149	0.012	[0.125, 0.173]
No	0.082	0.004	[0.075, 0.089]
First-generation			
Yes	0.071	0.007	[0.057, 0.0837]

No	0.093	0.004	[0.085, 0.102]
First-year foreign language experience			
Yes	0.151	0.015	[0.122, 0.180]
No	0.085	0.004	[0.078, 0.092]
First-year Pell Grant			
Yes	0.074	0.006	[0.062, 0.086]
No	0.094	0.004	[0.086, 0.102]

Note. [1]Robust standard errors were reported. [2]95% Confidence Intervals were reported.

as a student who did not any foreign language classes. The average predicted probabilities of participating in education for the former and latter groups were 15.1% and 8.5% respectively. A student who received a Pell Grant during the first year of college was 0.772 times as likely to participate in education abroad as a student who did not receive a Pell Grant during the first year of college. On average, a Pell Grant receipt had a 7.4% chance of participating in education abroad, while a non-Pell Grant receipt had a 9.4% chance.

A student with higher first-year GPA was more likely to participate in education abroad than a student with a lower first-year GPA. On average, for one-unit increase in first-year GPA, a student was 2.295 times as likely to participate in education abroad. As indicated in Figure 3, with the first-year GPA increasing, the probability of participating in education abroad increased as well. Especially when the first-year GPA was greater than 3.0, the increase was greater. However, first-year GPA was not a significant predictor of participating in education abroad when it was greater than 3.0. In another words, first-year GPA is stronger predictor of participating in education abroad when it was equal to or smaller than 3.0.

A student who had more advanced hours accepted by the institution was slightly more likely to participate in education abroad than a student who had less advanced hours accepted. On average, for one credit hour accepted increase, a student was 1.011 times as likely to participate in education abroad. College readiness was found to be an statistically insignificant predictor of participating in education abroad.

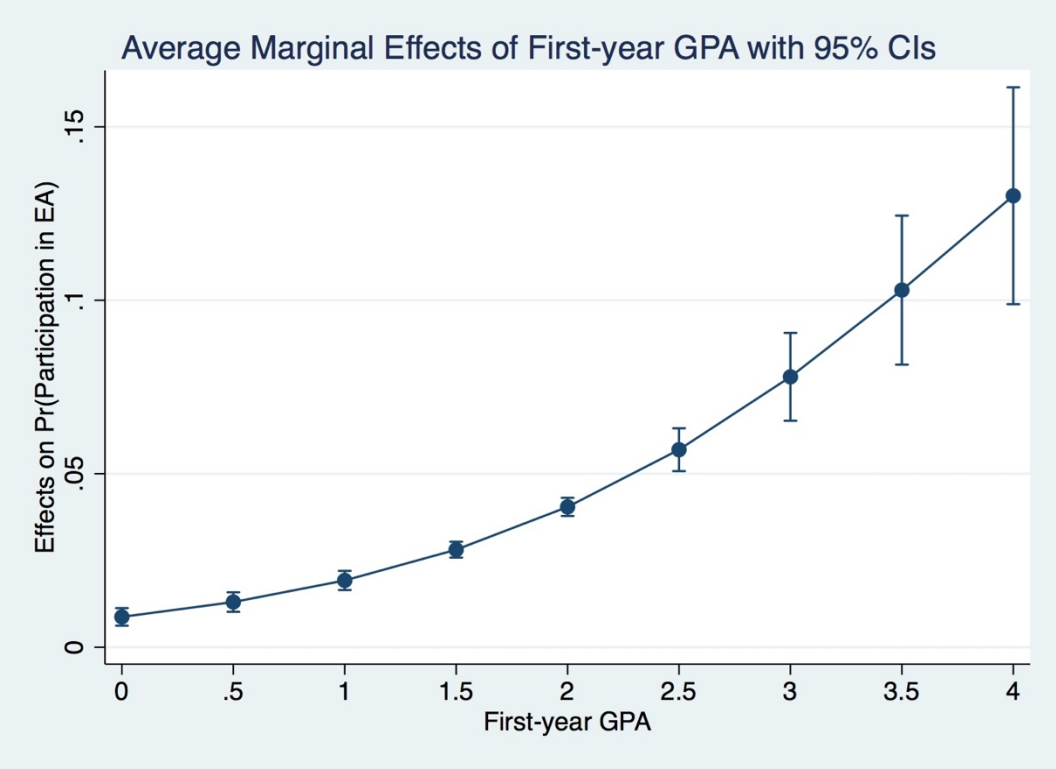

Figure 2.1 Probabilities of participating in education abroad across the first-year GPA

2.6.3 CART Analysis

Figure 4 presents the CART tree results of participation in education abroad in a four-year public institution. The rational to adopt CART for data analysis was to understand the potential factors that were associated with students' participation in education abroad and to identify the complex interactive effects among the factors. The CART analysis was run with eight independent variables: gender, URM, first-generation, first-year Pell Grant, first-year foreign language, first-year GPA, advanced hours accepted and college readiness. As indicated in Figure 4, five out of eight independent variables were finally used to stratify the sample on the basis of CART. Specifically, the CART analysis partitioned the sample into eight homogenous terminal nodes.

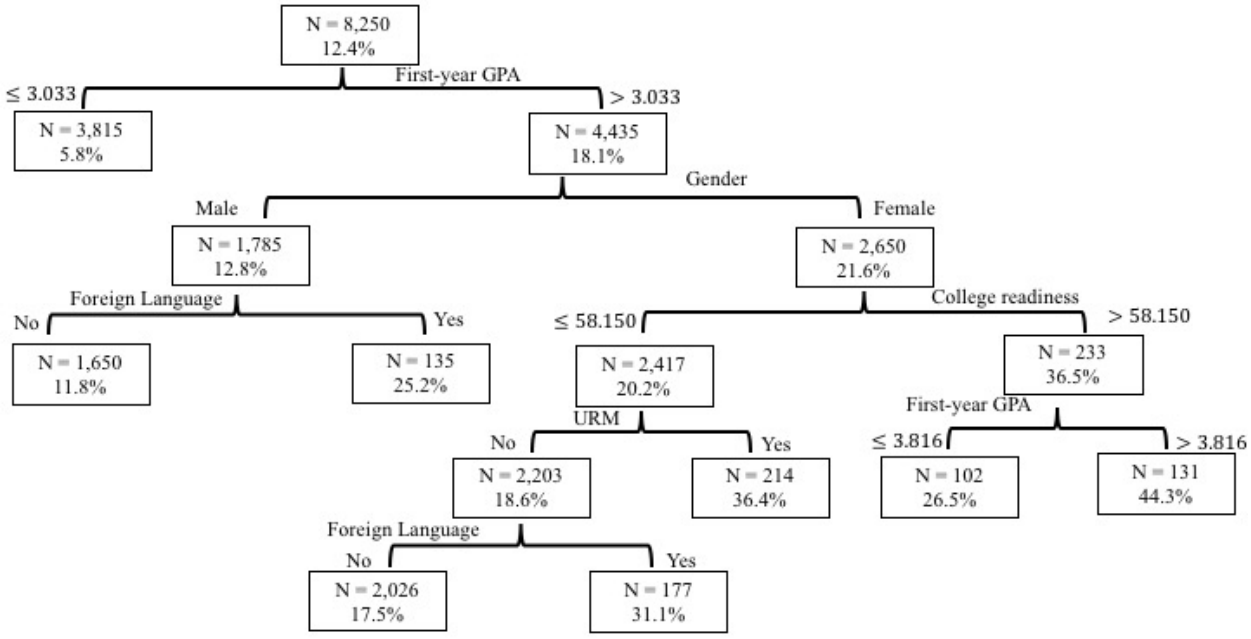

Figure 2.2 CART tree of participation in education abroad in a four-year public institution

The root node contained 8,250 students (the original sample size). The overall probability of participating in education abroad was 12.4%. First-year GPA produced the best or biggest impurity reduction among all potential confounding factors in this root nude, dividing it into two child nodes. One node contained 3,815 students with a first-year GPA equal to or smaller than 3.033, and the other one contained 4,435 students with a first-year GPA greater than 3.033. The probabilities of participating in education abroad were 5.8% and 18.1%, respectively, for the two child notes. The predictions of the model did not require splitting further the branch of a first-year GPA equal to or less than 3.033. Thus, the 3,815 students with a first-year GPA equal to or smaller than 3.033 formed a terminal node with a probability of participating in education abroad being 5.8%.

Among all the students with a first-year GPA greater than 3.033, the best predicator was their gender. The right node then became the parent node of two gender child nodes (male and

female). Female students were more likely to participate in education abroad than their male counterparts, with a condition that the first-year GPA was greater than 3.003. The 1,785 male students formed a parent node with a probability of participating in education abroad being 12.8%, which was further split into two child nodes depending on whether or not they had any foreign language experience during first year of college. For the 1,650 male student who did not have any foreign language experience, the probability of studying abroad was 11.8%. In comparison, the 135 male students who had some foreign language experience were more likely to participate in education abroad, with a probability being 25.2%.

The 2,650 female students with a probability of participating in education abroad being 21.6% formed a parent node that was divided into two child nodes depending on the measure score of college readiness: <= 58.150 and > 58.150. The 233 female students whose college readiness score was greater than 58.150 were more likely to participate in education abroad than the 2,417 female students whose college readiness was equal to or smaller than 58.150, with a condition that the first-year GPA was greater than 3.003. The probabilities were 36.5% and 20.2% respectively.

The 233 female students with a college readiness score greater than 58.150 were further divided into two child nodes depending on whether or not their first-year GPA score was greater than 3.816. The 102 students with a first-year GPA greater than 3.033 but equal to or smaller than 3.816 formed a terminal node with a probability being 26.5%, whereas the 131 student with a first-year GPA greater than 3.816 score formed another terminal node with a probability being 44.3%.

For the 2,417 female students whose first-year GPA was greater than 3.033 and whose college readiness score was equal to or smaller than 58.150 formed a parent node of two child nodes depending on whether they were URM students. The 214 URM students were more likely to participate in education abroad than the 2,203 non-URM students. The former group formed a

terminal node with a probability being 36.4%. The latter group was further portioned into two terminal nodes according whether or they had any foreign language experience. The 2,026 students who did not have any foreign language had a probability of participating in education abroad at 17.5%, whereas the 277 students who had some foreign language experience had a probability of participating in education abroad at 31.1%.

In sum, the eight terminal nodes demonstrate dramatically different probabilities of participating in education abroad in a four-year public institution. The probabilities range from 5.8% to 44.3%. This study using CART analysis was able to identify eight terminal nodes for sample stratification. Each student in the data sample fell into one of these terminal nodes and these eight terminal nodes defined eight strata for entire data sample.

Students who were least likely to participate in education abroad were students whose first-year GPA is equal to or lower than 3.003 (10.7%). Students who had the second least likelihood to participate in education abroad were male students without any foreign language experience during first year of college and with a first-year GPA greater than 3.033 (11.8%). Students who were most likely to participate in education abroad were females URM students whose first-year GPA was greater than 3.816 and whose college readiness score was greater than 58.150 (44.3%).

Overall, both CART and logistic regression analyses showed 87.6% of the correct classification of participation in education abroad. The area under the ROC curve of CART and binary logistic regression was 0.717 and 0.724 respectively. Both areas under the curve are significantly different from the true area 0.5, indicating that both models classified the group significantly better than by chance.

Table 2.5 Overall classification performance of CART and logistic regression

	CART	LR
Correctly classified cases	87.6%	87.6%
Area under ROC curve	0.717***	0.724***
95% [1]CI	[0.701, 0.732]	[0.708, 0.739]

Note. [1]95% confidence intervals were reported.

*P ≤ .05. **P ≤ .01. ***P ≤ .001.

2.7 Conclusions

In recent years, college students have increasingly been encouraged to participate in education abroad. With the growth and expansion of education abroad over the years, there has also been consistent attention to understanding the education abroad participant profile to develop strategic policies and programs to promote broader student access and inclusion. I undertook this study to understand the factors that were associated with students' participation in education abroad utilizing both logistic regression and CART analyses.

Logistic regression approach is rooted in sound statistical theory and has the ability to measure the relative strengths of each of the independent variables as well as provide a scale of probabilities of participating in education abroad. Using CART, I was able to identify important variables used to split nodes and capture the complex interactive effects of significant independent variables. Through this methodological lens, this study aimed to contribute to the literature on factors that are associated with students' participation in education by reconciling the results from both methods.

The results from logistic regression analysis demonstrated that all of the eight independent variables included in the model are statistically significant predictors of participating in education

abroad (see Table. 3). I included all eight independent variables when running the CART analysis, and five out of the eight independent variables were used to grow the classification tree (see Figure. 4). It can be concluded that the five independent variables included in the output produced better impurity reduction, in comparison to the unused three variables: first-generation, first-year Pell Grant, and advanced hours accepted. However, it does not indicate that first generation, first-year Pell Grant, and advanced hours accepted were insignificant factors related to participation in education abroad. It could be possible that all the variables would be included when a CART tree had more levels. Although there is no consensus in the literature regarding the appropriate number of levels for a CART tree, it is a common practice to limit the depth of a CART tree to tree to five levels (Ma, 2018). The discussion on the size of a CART tree often focuses on how a CART tree could capture the essential relationship among independent variables and avoid overfitting of a CART tree.

The results of this study confirm and extend previous studies. This study found that students majoring in arts, humanities, communication, business, and communication were more likely to study abroad than students with science majors, such as engineering. The results support the findings that students with higher academic performances were more likely to participate in education abroad (Paus & Robinson, 2008; Luo & Jamieson-Drake, 2015; Salisbury et al., 2010, 2011; Thomas & McMahon, 1998). Results from CART analysis suggest that first-year GPA was the best predictor of participation in education abroad. A first-year GPA with a score point of 3.033 produced the most impurity reduction and split the whole sample into two subgroups. Students whose first-year GPA greater than 3.229 were about 12.3 percentage points more likely to participate in education abroad than students whose first-year GPA was equal to or smaller than 3.003. Logistic regression analysis results also confirm that with the first-year GPA increasing, the

probabilities of students participating in education abroad increased. Especially when the first-year GPA was greater than 3.0, the increase was greater.

Additionally, in terms of another academic performance indicator – college readiness as measured by college admission index – students who had a higher college admission score were more likely to participate in education abroad. Logistic regression analysis results show that college readiness was not a significant predictor of participation in education abroad. However, CART analysis results demonstrate that the differences of college readiness in the probabilities of participating in education abroad exist in female students with a first-year GPA greater than 3.033.

Concerning demographic characteristics, the study supports prior research suggesting that female students were more likely to participate in education abroad than their male counterparts (Salisbury, Paulsen, & Pascarella, 2010, 2011; Dessoff, 2006; Stroud, 2010; Simon & Ainsworth, 2012). Results from logistic regression analysis reveals that a male student was 0.509 times as likely to participate in education abroad as a female student, holding other independent variables constant. On average, the predicted probabilities of participating in education abroad for a female student was about 5.5 percentage points higher than a male student. CART results demonstrate that female was the best predictor of participating in education abroad when the first-year GPA was greater than 3.033. Furthermore, among all the students whose first-year GPA was greater than 3.033, female students were more likely to participate in education abroad. This interesting result from CART analysis suggests that whenever one talks about the probabilities of participation in education abroad in relation to first-year GPA, one should not fail to mention that there are gender differences in the probabilities of participating in education abroad among students with a first-year GPA greater than 3.033.

Unlikely previous research, this study found that, with all else equal, URM students were more likely to participate in education abroad than white and Asian students. The results from logistic regression in relation to the average effect of URM on the likelihood to participate in education abroad indicate that a URM student was 1.963 more likely to participate in education abroad than a non-URM student. Based on the CART results, race differences in the probabilities of participating in education abroad exist in female students with higher first-year GPA and lower college readiness score. Specifically, a female URM student with a higher first-year GPA was more likely to participate in education abroad than a non-URM female student, with a condition that the first-year GPA was greater than 3.033 and the college readiness score was equal to or smaller than 58.150.

As expected, students who had experiences of learning at least one foreign language are more likely to participate in education abroad, which aligned with the findings of previous research (Goldstein & Kim, 2006). Logistic regression analysis results indicated that having had at least one foreign language class during first year of college was 1.910 times more likely to participate in education abroad than students who did not have any foreign language class during first year of college. Based on CART results, the differences in the probabilities of participation in education abroad resulted from first-year foreign language experience exist both in male students with a first-year GPA greater than 3.033 and in non-URM female students whose first-year GPA was greater than 3.033 and whose college readiness score was equal to and smaller than 58.150.

Although three of the eight independent variables were not used to grow the CART tree, they were all statistically significant predictors of participation in education abroad in logistic regression. Students who were not first-generation were 2.5 percentage points more likely to participate in education abroad than first-generation students. Students who did not receive any

Pell Grant during the first year of college were 2.1 percentage points more likely to participate in education than Pell Grant recipients. The findings support previous studies that financial needs negatively influenced students' likelihood to participate in education abroad (Sutton & Rubin, 2010; Whately, 2017; Simon & Ainsworth, 2012).

This study used both logistic regression and CART analyses to understand the education abroad participation profile. Logistic regression examined the average effect of each independent variable on the likelihood to participate in education abroad, while CART was able to capture the complex interactive effects among independent variables and present the effects in an intuitive way.

2.8 Discussion

In order to promote equity and inclusion in education abroad participation, it is essential for education abroad researchers and practitioners to understand who studies abroad, who does not, and why. By developing a more nuanced understanding of the profile of education abroad participation, colleges and universities will be able to strengthen their commitment to expand education abroad opportunities to the underrepresented populations.

The findings of this study present a series of implications for education abroad researchers, practitioners, and faculty, as well as senior administrators and policy makers. First, this study reveals a range of factors influencing students' participation in education abroad. Second, this study reveals a complex interplay among these factors. The long-standing gap in the likelihood to participate in education abroad between male and female students is replicated in this study. This finding suggests that efforts are needed to boost male participation by examining how each gender is socialized to enhance their educational experiences during college. Contrary to previous studies,

this study found that URM students are more likely to participate in education abroad than white and Asian students in this specific four-year public institution. This might relate to the efforts that this institution has put into recruiting URM students. This study found that academic performance is a very important factor associated with students' participation in education. Students whose first-year GPA was lower than 3.033 had the lowest likelihood to participate in education abroad, in comparison to other sub-groups based on the CART results. This suggests that education abroad offices may consider creating flexibility regarding eligibility requirements for students to participate in education abroad to make sure all students, not just the academically advanced students, have access to study abroad. Not surprisingly, this study presents that financial background is a significant factor influencing student's participation in education abroad. Given the realities of a tight university budgets, universities may consider providing more funding opportunities for low-income students to ensure that finance will not deter them from participating in education abroad.

This study further found that students majoring in sciences, especially students from the college of sciences and the college of engineering, were less likely to study abroad than students majoring in arts, communication, business, and humanities. There are reasons for the gap. Sciences and engineering programs often have rigid semester-by-semester academic planning and internship expectations, which give students less flexibility to fit in a semester to study abroad. Other reasons can be a lack of encouragement from academic advisors, difficulty in transferring credits for the courses taken abroad, fewer available science and engineering-related education abroad programs, and language of instruction. Recognizing these barriers, colleges and universities should work to expand education abroad opportunities for science and engineering students, such

as making their curricula more flexible, weaving opportunities into the curriculum and creating new programs.

Methodologically, this study used both logistic regression and CART analyses to contribute to the literature on factors that are associated with students' participation in education abroad by providing a more detailed profile of education abroad participation. Additionally, the findings from this study suggest researchers need to attend to complex selection factors associated with education abroad participation in order to reduce bias when estimating impacts. Education abroad is a self-elective activity and students from more advantaged groups are more likely to study abroad. While assessing the effects of education abroad, most of the studies failed to take into consideration the issue of self-selection. In order to reduce the effect of selection bias, it is essential to select a comparison group that could share the similar likelihood to participate in education abroad with the treatment group at the baseline. Thus, the factors revealed in this study could inform future education abroad assessment research when selecting a more comparable group, such as gender, race, financial background, parental education background, academic performance, major, and foreign language experience. Additionally, results from CART suggest several interactive effects should be tested in future research, especially the interactive effect between academic performance and gender.

While the findings presented in this study contribute to the literature on the factors associated with education abroad participation, additional research is needed to address some of the limitations. First, the data used for this study was collected at a single four-year public university. In order to increase the external validity, there is a need to understand how institutional settings and characteristics might influence students' participation in education abroad and impact further broader outcome. There are still unmeasured characteristics influencing students'

likelihood to participate in education abroad, such as students' intercultural attitudes and students' college involvement, neither of which were included in the dataset. In addition, it is important to understand students' perceptions towards the affordability and accessibility of education abroad participation.

CHAPTER 3. ASESSING THE IMPACT OF EDUCATION ABROAD ON STUDENT SUCCESS IN A FOUR-YEAR PUBLIC UNIVERSITY

3.1 Introduction

A substantial body of research has indicated that a key factor of whether students will succeed in college is the extent to which they will engage in educationally effective activities (Tinto, 1993; Astin, 1984; Kuh, 2008). High-impact practices (HIPs), put forth and endorsed by American Colleges and Universities (AAC&U), have been proven to lead to a range of positive outcomes for students (Kuh et al., 2005). Education abroad, as one of the HIPs, aims to enhance students' learning and success (Kuh, 2008). Multiple definitions of student success in college are often referred to as persistence, educational attainment, or achieving an expected degree or credential. The more commonly used measures of student success are the quantifiable indicators related to college completion, such as time-to-degree, graduation rate, and degree attainment (Venezia, Callan, Finney, Kirst, & Usdan, 2005). One indicator that has received most of the attention is the 4-year and 6-year graduation rates.

In an era of ever-greater accountability and cost-benefit analysis, examining the relationship between education abroad and college completion is important because of the increased attention to education abroad at the expense of other possible offerings, especially at a time when public institutions face increased budget constraints (Paige, Cohen, & Shively, 2004). By addressing the current methodological and design challenges within the field of education abroad, this study investigated the relationship between education abroad and 4-year and 6-year graduation rates at a four-year public university by answering the following research questions:

- What are the effects of participation in education abroad on students' 4-year and 6-year graduation rates in a four-year public institution?

- How does the duration of education abroad impact students' 4-year and 6-year graduation rates in a four-year public institution?
- How does the number of education abroad experiences impact students' 4-year and 6-year graduation rates in a four-year public institution?

3.2 Conceptual Framework

The conceptual framework for this study includes select aspects of the two most cited theoretical models in college student success literature: Tinto's interactionalist model of student departure (1975, 1993) and Astin's theory of involvement (1984).

Tinto's interactionalist model of individual student departure and Astin's theory of involvement are the most widely discussed and cited theories in the higher education literature. Pascarella and Terenzini (1991) pointed out that Tinto's theory is "quite similar to Astin's in its dynamics" (p.51). Both theories address the relationship between student involvement and educational outcome, and both emphasize the critical role of involvement in students' process of persistence and graduation in college. Astin (1984) defined student involvement as "the amount of physical and psychological energy that a student devotes to the academic experience" (p. 518). He concluded that factors contributing to student persistence in college were associated with student involvement. In addition to supporting the importance of involvement in student college life, Tinto (1993) suggested studies to better understand the impact of student involvement in learning on their college life. He clearly described that "the more students learn, the more likely they are to persist" (Tinto, 1993, p.131).

Tinto (1993) postulated that students become integrated into college academically and socially when they successfully navigate three stages of college integration: separation, transition,

and incorporation. Students first must separate themselves from the norms and patterns of their past lives, including their families, high school peers, and other communities that they were formerly associated with. Upon a successful negotiation of separation, students undergo a period of transition by interacting with members from the new community in new ways. Incorporation happens when students adopt the normative values and behavior patterns of their new college communities. The incorporation stage requires students' academic and social integration. Academic integration represents the level of satisfaction that students have with both explicit norms, such as earning passing grades, and the normative academic values of the institution. Academic integration is often measured as students' satisfaction with academic progress and choice of major (Kuh et al., 1994). Social integration reflects the extent to which students find that an overall institutional social environment is congenial with their preferences; it is often measured as a composite of peer-to-peer interactions and faculty-student interactions (Kuh et al., 1994). Academic and social integration helps students adjust to college life and navigate the stage of transition and enter the stage of incorporation. Successful integration does not ensure persistence, but it will increase the likelihood of persistence and graduation (Milem & Berger, 1997; Kuh, Kinzie, Buckley, Bridges, & Hayek, 2006). However, what facilitates the process of integration?

Astin's involvement theory becomes helpful in addressing this question in depth and expanding our understanding of Tinto's model. Astin (1975) argued that this process of integration happens through students' involvement in college. Astin (1984) suggested five basic postulates for his involvement theory: (a) Involvement refers to students' involvement of their physical and psychological energy in various objects that range from high generalizability to high specificity; (b) Involvement occurs along a continuum, which can be different degrees of involvement in a given subject among different students or it can be different degrees of involvement with various

objects at various times for the same student; (c) The extent of students' involvement can be measured both quantitatively and qualitatively; (d) the amount of student learning and personal development associated with any educational program is directly proportional to the quality and quantity of the involvement; (e) the capacity of any educational policy or practice to increase student involvement is a direct indicator of the effectiveness of that policy or practice. Astin (1984) highlighted that the last two points provide helpful guidelines to design more effective educational programs and practices for students, and they are subject to empirical proof to be tested.

Taken together, these theories provide a comprehensive list of key factors that influence students' experiences in college and the meanings that they make of their experiences. In their review of the theories of college student educational attainment and persistence, Pascarella and Terenzini (2005) concluded the following:

> Theories emphasize a series of academic and social encounters, experiences, and forces that can be portrayed generally as the notions of academic or social engagement or the extent to which students become involved in (Astin, 1985) and integrated (Tinto, 1975, 1987, 1993) into their institution's academic and social systems. (p.425)

Empirical studies have also supported the positive relationship between higher levels of meaningful engagement on campus and student persistence and degree completion (Milem & Berger, 1997; Braxton, Sullivan, & Johnson, 1997; Kuh, Kinzie, Buckley, Bridges, & Hayerk, 2011).

Building on previous literature, Kuh (2008) outlined ten categories of high-impact practices (HIPs) that have been determined to be beneficial for college students' persistence towards graduation: first year seminars and experiences, common intellectual experiences,

learning communities, writing-intensive courses, collaborative assignments and projects, undergraduate research, diversity/global learning; serving learning, community-based learning, and internships and capstone courses and projects. These HIPs share several common traits: they require students to invest considerable time and effort, provide opportunities for students to learn and practice outside of the classroom, require meaningful interactions with faculty and peers, promote collaborations with diverse others, and offer frequent and substantively feedback (National Survey of Student Engagement [NSSE], 2005).

Within the category of diversity and global learning, Kuh (2008) identified education abroad as one of the HIPs to foster student involvement. Education abroad courses and programs can provide students the opportunities to explore and understand culture, life experiences, and worldviews that are different from their own. In addition to the development of global and multicultural outcomes, through involvement with education abroad programs, students can also enhance their academic and social integration, such as interacting and collaborating with program-led faculty, peers and diverse others; applying what they are learning into real-world settings, etc. These integrations in turn increase the likelihood a student will persist and graduate. Thus, within the theoretical framework of Tinto's interactionalist model (1975, 1987, 1993) and Astin's theory of involvement (1984), I hypothesize that education abroad programs will yield greater likelihood in college completion for students.

3.3 Literature Review

A few previous empirical studies have investigated the relationship between participation in education abroad and college completion (Johnson & Stage, 2018; Malmgren & Calvin, 2008; Hamir, 2011; O'Rear, Sutton, & Rubin, 2012; Xu, Silva, Neufeldt, & Dane, 2013). Within a single

institution, Hamir (2011) compared three groups of students: education abroad participants, education abroad applicants, and non-education abroad participants at the University of Texas at Austin. He found that participation in education abroad had positive effects on 4-year, 5-year, and 6-year graduation rates compared with either education abroad applicants or non-education abroad participants. At Michigan State University, Ingraham and Peterson (2004) found that education abroad participates enrolled for more terms (such as summer or winter terms, in addition to spring and fall terms) but took less time to graduate, compared with non-education abroad participants. Malmgren and Calvin (2008) found that students who participated in education abroad had statistically significantly higher 4-year, 5-year, and 6-year graduation rates than student who did not participate in education abroad at University of Minnesota, Twin Cities. Xu et al. (2013) explored the impact of participation in a semester-long education abroad program on graduation rates at Old Dominion University. The results demonstrated that students who participated in a semester-long education abroad program were more likely to graduate within 5 and 6 years, but not within 4 years.

Beyond studies within a single institution, three research projects have used data collected across multiple institutions to examine the relationship between participation in education abroad and college completion. The University System Georgia Learning Outcomes of Students Studying Abroad Research Initiative (GLOSSARI) included undergraduates from 33 institutions within the University System of Georgia. These findings suggested that students who studied abroad were 7.5 percentage points higher in the probability of graduating within 4 years, 7.9 percentage points higher in the probability of graduating within 5 years, and 5.3 percentage points higher in the probability of graduating within 6 years (O'Rear, Sutton, & Rubin, 2012; Sutton & Rubin, 2010). In another study, Johnson and Stage (2018) examined the relationship between 10 HIPs and

graduation rates across 101 public colleges and universities in the United States. Contrary to the findings from previous studies, this study found no statistically significant correlation between participation in education abroad and 4-year and 6-year graduation rates. This study also revealed that participation in education abroad was not a significant predictor of 4-year and 6-year graduation rates. The most recent study—the Consortium for Analysis of Student Success through International Education (CASSIE)—has collected their own dataset across 36 institutions, aiming to employ statistical matching techniques to provide a robust examination of the impact of education abroad on college completion (CASSIE, 2017). However, the findings of this study have been not published yet.

In addition, several studies have also examined the varied effects of education abroad on college completion across underrepresented subgroups. Malmgren and Calvin (2008) found that students of color with education abroad experiences had a statistically significantly higher percentage of 4-year, 5-year and 6-year graduated students than students of color who did not have any education abroad experiences. Rubin et al. (2014) found that participation in education abroad could enhance academic success for lower academically achieving students.

The literature has explored the relationship between participation in education abroad within a single institution, across multiple institutions, and across subgroups. Most of the literature relied on two analytic approaches. Some of the studies used chi-square analyses to examine whether there were statistically significant differences in graduation rates between education abroad and non-education abroad participants (Hamir, 2011, Malmgren & Calvin, 2008). Several studies have conducted logistic regression analyses to examine the effect of education abroad on graduation after controlling for demographics and prior academic achievement factors (O'Rear, Sutton, & Rubin, 2012; Sutton & Rubin, 2010, Xu et al., 2013; Hamir, 2011, Johnson & Stage,

2018). However, a potential threat to internal validity—selection bias— has not been addressed in these empirical studies.

In an ideal experimental study, the causal effect of participation in education abroad can be estimated by the simple difference in observed means of treatment and non-treatment groups (Thoemmes & West, 2011). Without a random assignment of an education abroad program, any assessment of the effect of participation in education abroad is subject to selection bias. Participation in education abroad is not randomly assigned, but self-selected. Choosing to apply for or participate in an education abroad program depends on active choices of students. These choices typically depend on students' demographic characteristics and prior academic achievement factors. For example, previous studies found that white and female students of higher socio-economic status were more likely to participate in education abroad (Dessoff, 2006; Stroud, 2010; Simon & Ainsworth, 2012; Booker, 2001). Additionally, students of higher academic performance were more likely to participate in education abroad (Paus & Robinson, 2008; Luo & Jamieson-Drake, 2015; Salisbury et al., 2010, 2011; Thomas & McMahon, 1998). The problem is that these underlying factors may impact group selection and then lead to potentially biased estimates. Thus, simply comparing education abroad and non-education abroad groups will likely cause a biased treatment effect estimate. One way to minimize the impact of selection bias is through the use of propensity score matching (PSM). PSM allows researchers to balance nonequivalent groups through matching on a singular scalar variable (Rosenbaum & Rubin, 1984). A few studies have also addressed the major issue of the selection bias within the field of education abroad and importance of employing a matching approach to select a comparison group, but none of them have provided empirical evidence using propensity score matching (Haupt, Ogden, & Rubin, 2018; CASSIE, 2017).

Using PSM, this study aimed to get a better estimate of treatment effect of participation in education abroad on graduation rates by selecting a comparison group who shared similar likelihood to participate in education abroad as the treatment group. Additionally, this study employed PSM to explore how education abroad duration and times of education abroad experiences impact graduation rates. Specifically, this study investigated the following research questions:

- What are the effects of participation in education abroad on students' 4-year and 6-year graduation rates in a four-year public institution?
- How does the duration of education abroad impact students' 4-year and 6-year graduation rates in a four-year public institution?
- How does the number of education abroad experiences impact students' 4-year and 6-year graduation rates in a four-year public institution?

3.4 Method

3.4.1 Data

This study used a data sample consisting of two cohorts of undergraduate students who matriculated to a large 4-year public research university in the mid-east of the United States for the first time and full time in Fall 2010 and Fall 2011. The data sample was compiled through two data sources: (a) the institutional records that captured students' background characteristics prior to college and their academic pathways in college and (b) the education abroad data that tracked education abroad participation and provided additional information on education abroad programs. The final data sample consisted of 8,250 students, 1,025 of whom had some education abroad experience during college. The two data sources were merged-using a unique student identifier.

3.4.2 Measures

The primary outcomes of interest were students' 4-year and 6-year graduation rates. They were the percentages of first-time full-time bachelor's degree-seeking students who completed their degree within four or six years since they matriculated to the institution. Three main independent variables were included for this study: participation in education abroad, duration of education abroad, and number of education abroad experiences. The variable of education abroad participation indicates whether a student ever participated in any education abroad program in college. The duration of education abroad indicates how long in total a student studied abroad through one or more education abroad programs, which includes four categories: none, less than a semester, one semester, more than one semester. The number of education abroad experiences

indicates how many times in total a student participated in education abroad in college, which includes three categories: none, one time, and more than one time.

For the confounding variables, this study used several student demographic, financial, and academic characteristics and background reported from the institutional records, including gender, race/ethnicity, first-generation status, college readiness, number of advanced credits hours accepted by the institution prior to matriculation, first-year GPA, first-year Pell Grant, and first-year foreign language experience. Indicators of a student's cohort year and home college claimed by the beginning of second year were also included for this study.

3.4.3 Analytic Strategies

3.4.3.1 PSM

The goal of the study is to examine the effects of education abroad participation, duration of education abroad, and number of education abroad experiences on students' 4-year and 6-year graduation rates. As discussed earlier, participation in education broad is not randomly assigned, but self-selected. Additionally, choosing to participate in a certain type of education abroad program and how many times also depend on students' background, motivation, and available opportunities. Thus, without a random assignment of the treatment, the assessment of the effects of education abroad participation, duration of education abroad, and number of education abroad experiences is subject to selection bias. In order to mitigate selection bias, this study used PSM to select a comparison group for each treatment group. In the following section, I discuss how PSM was employed in this study through a three-step analytic process: covariate selection, estimating propensity scores, and matching.

A correct specification of covariates at the baseline prior to the treatment is crucial to the PSM approach because the final estimate of the treatment effect is sensitive to this specification (Rubin, 1997). Previous studies have shown that the choice of matching variables can make a substantial difference in the overall performance of the PSM analysis (Heckman et al., 1997; Lechner, 2000). A thorough review of literature is often the first step when selecting the covariates for the propensity score estimation model. Two statistical strategies are recommended while selecting appropriate conditioning variables (Rosenbaum & Rubin, 1985):

- Using a bivariate method to test whether the treated and untreated groups differ on covariates, such as t-test, chi-square, etc;
- Applying stepwise regression analyses to select variables. The inclusion or exclusion of any conditioning variable can be based on a Wald statistic and its associated *p* value. All the variables that are significant at a predetermined level should be included.

Additionally, Rosenbaum and Rubin (1985) suggested to calculate standardized bias (SB) for each covariate, which measures the standardized mean difference relative to the variability of the values in the covariate distribution. Any covariate that has a SB that is bigger than 10% should be considered to be included in the propensity score estimation model.

Study 1 informed the process of selecting the covariates for this study. Based on the empirical evidence of previous literature and the availability of the longitudinal dataset, the findings of paper 1 using bivariate analyses, logistic regression, and classification and regression tree suggested that there were differences between education abroad and non-education abroad participants in several areas:

- Demographics: gender and race/ethnicity;

- Socio-economic background: first-year Pell Grant recipients and first-generation students,
- Prior academic performances: college readiness, advanced hours accepted prior to matriculation to college, and first-year GPA;
- Interests in foreign language: first-year foreign language experience;
- College; and
- Cohort year.

For estimating the propensity scores, logistic regression appears to be the most commonly used approach (Rosenbaum & Rubin, 1983), in which the treatment status is regressed on observed covariates selected at the baseline. The estimated propensity score for each observation subject is the predicted probability of receiving the treatment derived from the fitted logistic regression model. For this study, I used a binary logistic regression model to predict the propensity score that an individual student would participate in education abroad, as the treatment of participation in education abroad is a binary variable. For duration of education abroad and numbers of education abroad experiences that have multiple treatment categories, I used multinomial logistic regression models to predict the propensity scores. Thus, for each individual student, the probability of receiving each treatment category given the observed covariates was estimated.

Once the propensity scores were estimated, I used the nearest neighbor matching within a specified caliper distance to match students in the treatment group with students in the comparison group based on their propensity scores. In this matching process, a treated student was first selected randomly. Then all the untreated students whose propensity scores lay within a specified caliper of that of the treated student would be identified. Among all the identified untreated students, the one who had the closest propensity score to that of the treated student would be selected for matching. For the caliper bandwidth, Rosenbaum and Rubin (1985) recommended that it should

be no greater than 0.25 of the standard deviation of the propensity scores. Austin (2011) examined optimal caliper widths and suggested that using a caliper equal to 0.20 of the standard deviation of propensity scores minimized the mean square error of the estimated treatment effects. For this study, I set the caliper bandwidth as 0.20. I used one-to-one matching, in which a treated student would be only matched to one untreated student. I set up all the matching in this study without replacement, which means that once an untreated student has been selected for matching, it becomes unavailable for consideration as a potential match for any other treated students.

After the matching is done, it is important to assess the comparability of treated and untreated groups in a matched sample (Rosenbaum & Rubin, 1985; Austin, 2008). I first computed the absolute standardized difference or standardized bias, which compares the difference in means in units of the pooled standard deviation between treated and untreated groups before and after matching (Rosenbaum & Rubin, 1985; Austin, 2011). For a continuous variable, the standardized bias is defined as

$$B = \frac{\bar{x}_{treated} - \bar{x}_{untreated}}{\sqrt{\frac{SD_{treated}{}^2 + SD_{untreated}{}^2}{2}}} \times 100\%$$

Where $\bar{x}_{treated}$ and $\bar{x}_{untreated}$ denote the sample mean of the covariate in the treated and untreated groups respectively. $SD_{treated}$ and $SD_{untreated}$ denote the sample variance of the covariate in the treated and untreated groups respectively. For a dichotomous variable, the standardized bias is defined as

$$SB = \frac{\hat{p}_{treated} - \hat{p}_{untreated}}{\sqrt{\frac{\hat{p}_{treated}(1 - \hat{p}_{treated}) + \hat{p}_{untreated}(1 - \hat{p}_{untreated})}{2}}} \times 100\%$$

where $\hat{p}_{treated}$ and $\hat{p}_{untreated}$ denote the proportion of the dichotomous variable with a certain characteristic in the treated and untreated groups, respectively. Although there is no agreed upon standard to be used to indicate any imbalance, an absolute standardized bias less than 10% after matching indicates that the matching is considered effective in reducing selection bias (Normand et al., 2001).

The percent bias reduction (PBR) is another commonly used indices to check the balance of covariates between treated and untreated groups after matching (Cochran & Rubin, 1973). It is defined as

$$PBR = \frac{|B_{beforematching}| - B_{aftermatching}|}{B_{beforematching}|} \times 100\%$$

Where $B_{beforematching}$ denotes the bias before matching, whereas $B_{aftermatching}$ denotes the difference in means or proportions of the covariate between treated and untreated groups after matching. A PBR more than 80% is often used as a benchmark to indicate the matching is effective in reducing bias (Cochran & Rubin, 1973; Rubin, 1980).

Additionally, I compared the distributions of propensity scores of treated and untreated groups before and after matching. I examined the common area of support, in other words, the degree of overlap in the propensity scores between treated and untreated groups after matching. Through examining the common support, I was able to identify unmatched treated individuals that were excluded for the outcome analyses. Both approaches serve as an assessment of whether the means of covariates included in the propensity core model are similar between treated and untreated groups after matching (Austin, 2011).

3.4.3.2 Logistic Regression with Fixed Effects

Once the treated students were matched with the untreated students, I proceeded with the outcome analyses using the matched samples. For each of the three independent variables—participation of education abroad, duration of education abroad, and number of education abroad experiences—a separate matched sample was generated using the PSM approach discussed above. I used binary logistic regression to examine the relationship between each of the independent variables and 4-year and 6-year graduation rates while accounting for the other covariates, as both outcome variables were dichotomous.

Additionally, I included college and cohort fixed effects in the logistic regression models. The dataset used for this study included students from different colleges and across two cohort years at a four-year public university. Thus, there are variations in graduation rates across colleges and cohort years. Students from the same college or the same cohort might share some unobserved characteristics. As a result, these unobserved characteristics might bias the estimated treatment effects. By including both college and cohort fixed effects, the shared unobserved students' characteristics within each college can be removed from the estimation and the variation occurring across cohort years can be absorbed.

The results of the study were drawn from statistical testing of the hypotheses. For the independent variable of participation in education abroad, there was only one treatment comparison: participation in education abroad vs. non-participation in education abroad. I specified the critical P level of significance or alpha as 0.05, which is the most acceptable cutoff to guarantee the probability of incorrectly rejecting a single test of null hypothesis no larger than 0.05. However, for the other two independent variables: duration of education abroad and number of education abroad experiences, there were multiple treatment comparisons. In other words, more than one hypothesis was simultaneously tested. The statistical probability of incorrectly rejecting

a true null hypothesis will significantly inflate among with the increased number of simultaneously tested hypotheses (Hsu, 1996). Thus, it is critical to guarantee that no null hypothesis is incorrectly rejected, when it comes to multiple treatment comparisons. Bonferroni adjustment is one of the most commonly used approaches for multiple comparisons (Bland & Altman, 1995). This method computes an adjusted P value by dividing the pre-specified significance level 0.05 by the total number of comparison groups. For the duration of education abroad, there were six comparison groups in total: non-education abroad vs. less than one semester, non-education abroad vs. equal to one semester, non-education abroad vs. more than one semester, less than one semester vs. equal to one semester, less than one semester vs. more than one semester, and equal to one semester vs. more than one semester. Thus, the adjusted P value should be 0.05/6=0.0083. For the number of education abroad experiences, there were three comparison groups in total: non-participation in education abroad vs. one education abroad experience, non-participation in education vs. more than one education abroad experience, one education abroad experience vs. more than one education abroad experience. Thus, the adjusted P value should be 0.05/3=0.0167.

Additionally, for the duration of education abroad and the number of education abroad experiences, I conducted post hoc tests after logistic regression analyses to examine if there were any significant differences between other treatment groups that were not included in the logistic regression results output. All the analyses described above were conducted using Stata SE/14.0 statistical software.

3.5 Results

3.5.1 Participation in Education Abroad

3.5.1.1 PSM Results

As indicated in Table 1.1, before matching, there was a statistically significant mean difference of the propensity scores between education abroad and non-education abroad participations, which was 0.093 with a standardized bias (SB) of 86.1%. After matching, the mean difference in propensity score between two groups dropped to 0.001 with a SB of 0.8%. The difference was not statistically significant and the new SB was less than 10%, which met the standard for balance suggested by Normand et al. (2010). The percent of bias reduction in propensity score was 99.0%, which indicates a sufficient overall bias reduction. Moreover, before matching, there were statistically significant differences in each of the eight covariates between education abroad and non-education participants. After matching, the differences were no longer statistically significant. Figure 1a indicates that the standardized bias decreased significantly across all covariates after matching.

I further compared the distributions of propensity scores of education abroad and non-education abroad groups before and after matching, as indicated in Figure 1b. The distributions of the matched education abroad and non-education abroad students were much more comparable than those of the unmatched education abroad and non-education abroad students. There was a substantial overlap of the propensity score distributions in the matched groups. Figure 1c provides the common support for the range of propensity scores across education abroad and non-education abroad students. Most of the education abroad students were matched with a non-education abroad student with a similar propensity score, except for six education abroad students who were off support. In other words, there were no comparable non-education abroad students with similar propensity scores for these six education abroad students. The characteristics of these six students are presented in Appendix Table A. The potential threats to both internal and external validity

caused by the exclusion of the six education abroad students in the outcome analyses will be addressed in the discussion session.

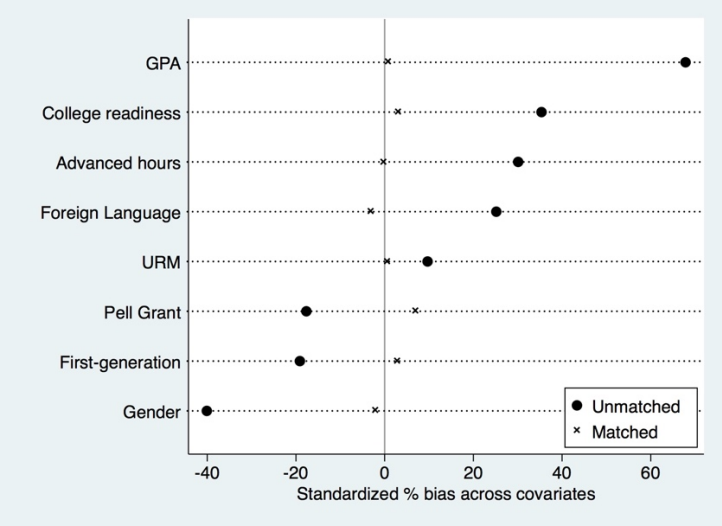

Figure 3.1 Standardized bias across covariates before and after matching for participation in EA

Table 3.1 Covariates Balance Results Before and After PSM for Participation in Education Abroad

	Before Matching				After Matching				
	EA	Non-EA	[1]Diff	SB (%)	EA	Non-EA	Diff	SB (%)	Reduction (%)
Propensity score	0.206	0.113	0.093**	86.1	0.203	0.204	0.001	0.8	99.0
URM	0.157	0.124	0.033**	9.7	0.155	0.153	0.002	0.6	94.1
Male	0.305	0.498	-0.193***	-40.1	0.308	0.318	-0.010	-2.0	94.9
First-generation	0.123	0.191	-0.068***	-19.1	0.123	0.112	0.011	3.0	84.4
Foreign language	0.141	0.065	0.076***	25.2	0.137	0.146	-0.009	-2.9	88.3
1st-year Pell Grant	0.179	0.252	-0.073***	-17.7	0.180	0.151	0.029	7.0	60.5
1st-year GPA	3.359	2.830	0.529***	67.8	3.355	3.348	0.007	0.9	98.7
College readiness	50.690	48.514	2.176***	35.4	50.666	50.473	0.193	3.1	91.1
Advanced hours	7.588	4.560	3.028***	30.1	7.514	7.520	-0.006	-0.1	99.80

Note. [1]For categorical independent variables, the differences in proportions were reported. Two-sample proportion tests were conducted. For continuous independent variables, the differences in means were reported. Two-sample t-tests were conducted.

*P ≤ .05. **P ≤ .01. ***P ≤ .001.

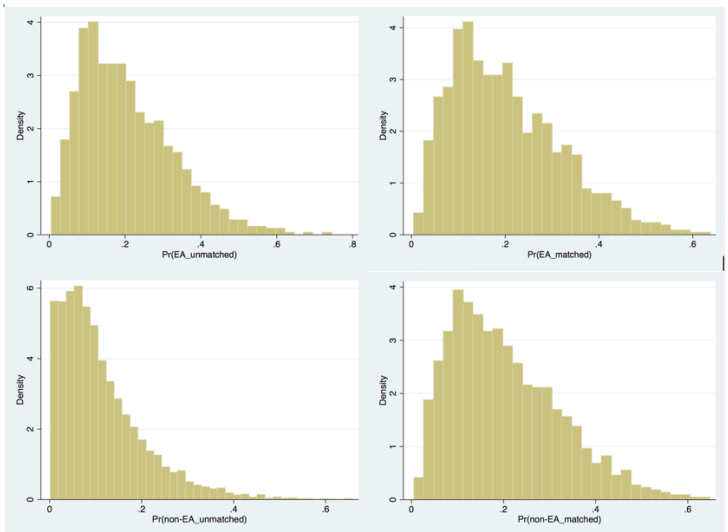

Figure 3.2 Histograms of propensity scores for EA and non-EA groups before and after matching

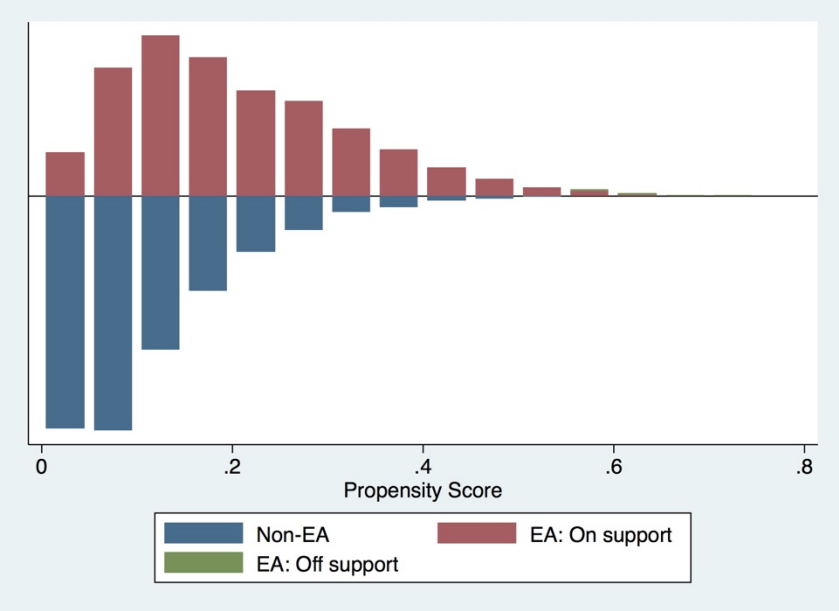

Figure 3.3 Common support of propensity scores between EA and non-EA groups after matching

3.5.1.2 Treatment Effect Estimates

Overall, participation in education abroad had a positive effect on students' 4-year graduation rates across all the models, as shown in Table 1.2. After controlling for the covariates and including the cohort and college fixed effects, the result on the matched sample after PSM indicates that education abroad students were more likely to graduate within four years than non-

education abroad students. On average, an education abroad student was 1.348 times as likely to graduate within four years than a non-education abroad student. With all the covariates being held at their means, the average predicted probabilities of graduating within four years for education abroad and non-education abroad students were respectively 55.9% and 48.5%, as indicated in Figure 1d. The difference of 7.4 percentage points was statistically significant.

Table 3.2 The Impact of Participation in Education Abroad on 4-Year Graduation Rates

4-Year Graduation					
	Before PSM				After PSM
	Model 1	Model 2	Model 3	Model 4	Model 5
EA (OR)	2.644***	1.587***	1.586***	1.370***	1.348**
	(0.179)	（0.117）	(0.117)	(0.107)	(0.131)
EA (MEM)	0.223***	0.098***	0.098***	0.062***	0.074***
	(0.016)	(0.016)	(0.016)	(0.015)	(0.024)
[1]Covariates	NO	YES	YES	YES	YES
Cohort fixed effects	NO	NO	YES	YES	YES
College fixed effects	NO	NO	NO	YES	YES
N (total)	8,250	8,225	8,225	8,225	2,034
Pseudo R^2	0.020	0.153	0.153	0.221	0.131
Log-likelihood	-5280.037	-4546.2799	-4546.1054	-4179.652	-1222.496
AIC	10564.073	9112.560	9114.211	8047.304	2490.991
BIC	10578.109	9182.709	9191.375	8575.663	2620.200

Note. [1]Covariates included gender, URM, first-year Pell Grant, first-generation, advanced hours accepted, first-year GPA, first-year foreign language experience, and college readiness.

Robust standard errors are in parentheses.

*P ≤ .05. **P ≤ .01. ***P ≤ .001.

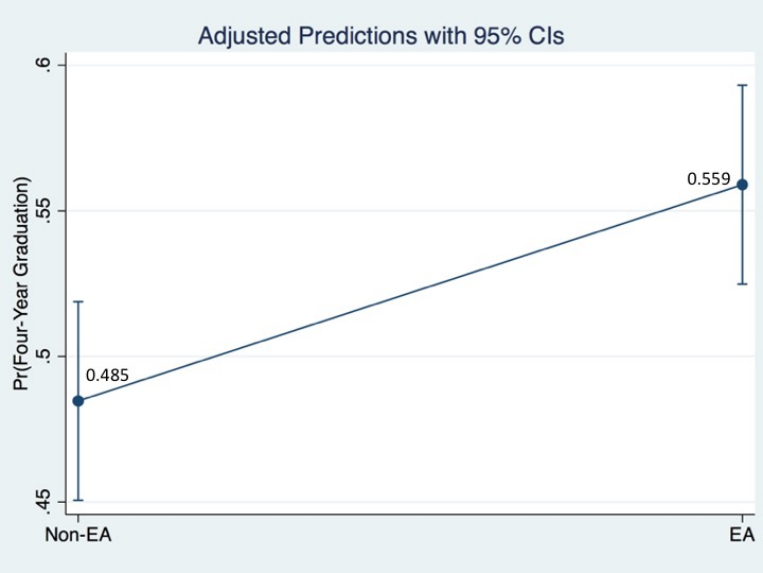

Figure 3.4 The average predicted probabilities of 4-year graduation for non-education abroad and education abroad students

Participation in education abroad also had a positive effect on students' 6-year graduation rates. The results after PSM in Table 1.3 indicate that an education abroad student was 3.475 times as likely to graduate within six-years than a non-education abroad student, after controlling for other covariates and including the cohort and college fixed effects. On average, an education abroad student had a 90.4% chance of graduating within six years, while an otherwise-comparable non-education abroad had a 73.1% chance, as indicated in Figure 1f. The average difference of 17.3 percentage points was statistically significant.

Table 3.3 (continued) The Impact of Participation in Education Abroad on 6-Year Graduation Rates

6-Year Graduation					
	Before PSM				After PSM
	Model 1	Model 2	Model 3	Model 4	Model 5
EA (OR)	5.045***	3.172***	3.171***	3.348***	3.475***
	(0.476)	(0.323)	(0.323)	(0.382)	(0.466)
EA (MEM)	0.386***	0.276***	0.276***	0.294***	0.173***

	(0.022)	(0.024)	(0.024)	(0.028)	(0.018)
[1]Covariates	NO	YES	YES	YES	YES
Cohort fixed effects	NO	NO	YES	YES	YES
College fixed effects	NO	NO	NO	YES	YES
Pseudo R^2	0.036	0.211	0.211	0.325	0.210
Log-likelihood	-5365.767	-4374.913	-4374.849	-3475.123	-832.674
AIC	10735.533	8769.825	8771.697	7536.245	1711.348
BIC	10749.569	8839.974	8848.862	7697.580	1840.557

Note. [1]Covariates included gender, URM, first-year Pell Grant, first-generation, advanced hours accepted, first-year GPA, first-year foreign language experience, and college readiness.

Robust standard errors are in parentheses.

*P ≤ .05. **P ≤ .01. ***P ≤ .001.

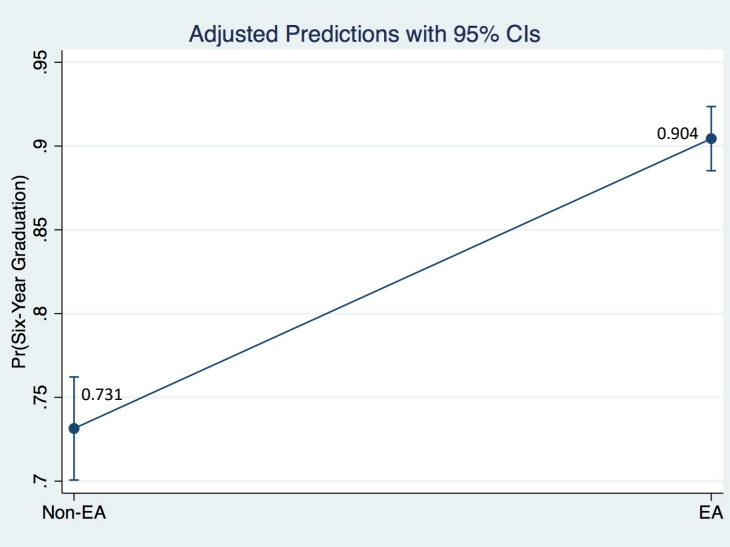

Figure 3.5 The average predicted probabilities of 6-yeargraduation for non-education abroad and education abroad students

3.5.2 Duration of Education Abroad

3.5.2.1 PSM Results

I used multinomial logistic regression models to predict the propensity score for each of the three treatment categories for duration of education abroad: one semester, equal to one

semester, and more than one semester. I matched the treated students from each of treatment categories with untreated students based on the propensity scores. Thus, three matching procedures were conducted. Table 2.1 presents the covariates balance results before and after matching between students who participated in education abroad for less than one semester and students who did not participate in education abroad. Before matching, the mean difference of the propensity scores between the two groups was 0.062 with a standardized bias of 86.11%. After matching, the mean difference decreased to 0.001 and was no longer statistically significant. Overall, there was a 98.4% bias reduction, indicating a substantial bias was reduced by all eight covariates. Additionally, there were statistically significant differences between the two groups among all covariates before matching. After matching, none of the differences remained statistically significant. Figure 2a visually indicates that the standardized bias decreased significantly across all covariates after matching. By comparing the distributions of propensity scores of the two groups before and after matching, we can see that the two groups were more comparable after matching, as indicated in Figure 2b. Figure 2c provides the common support for the range of propensity scores across the two groups. Most of the treated students were matched with untreated students with a similar propensity score. 2 out of 754 students who studied abroad for less than one semester were off support. The characteristics of these two students are presented in Appendix Table A.

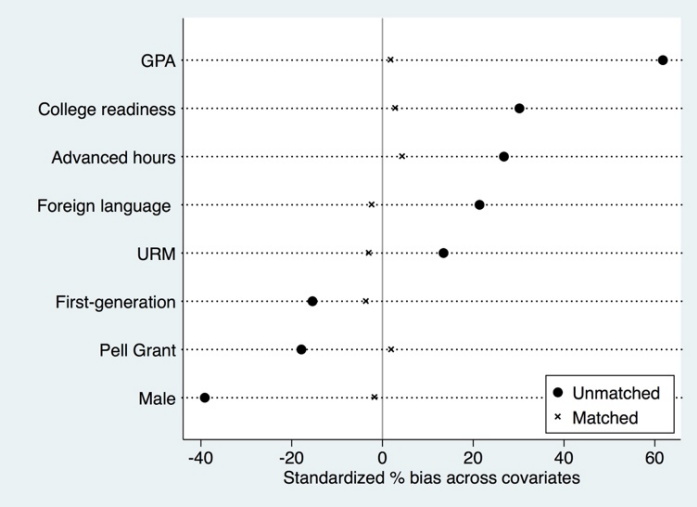

Figure 3.6 Standardized bias across covariates before and after matching for EA less than one semester

Table 3.4 Covariates Balance Results Before and After PSM between EA Less than One Semester (*n*=756) and non-EA

	Before Matching				After Matching				
	EA	Non-EA	[1]Diff	SB (%)	EA	Non-EA	Diff	SB (%)	Reduction (%)
Propensity score	0.146	0.084	0.062***	86.11	0.145	0.146	0.001	1.19	98.4
URM	0.171	0.124	0.067***	13.5	0.169	0.180	-0.011	-3.0	77.8
Male	0.310	0.500	-0.190***	-39.1	0.311	0.319	-0.008	-1.6	95.8
First-generation	0.134	0.191	-0.057***	-15.4	0.135	0.148	-0.013	-3.6	76.7
Foreign language	0.126	0.064	0.062***	21.4	0.124	0.131	-0.007	-2.3	89.4
1st-year Pell Grant	0.177	0.251	-0.070***	-17.9	0.179	0.171	0.008	1.9	89.1
1st-year GPA	3.316	2.830	0.486***	61.8	3.315	3.300	0.015	1.9	96.9
College readiness	50.387	48.514	1.873***	30.2	50.385	50.208	0.177	2.9	90.5
Advanced hours	7.250	4.559	2.691***	26.8	7.230	6.783	0.447	4.4	83.4

Note. [1]For categorical independent variables, the differences in proportions were reported. Two-sample proportion tests were conducted. For continuous independent variables, the differences in means were reported. Two-sample t-tests were conducted.

*P ≤ .05. **P ≤ .01. ***P ≤ .001.

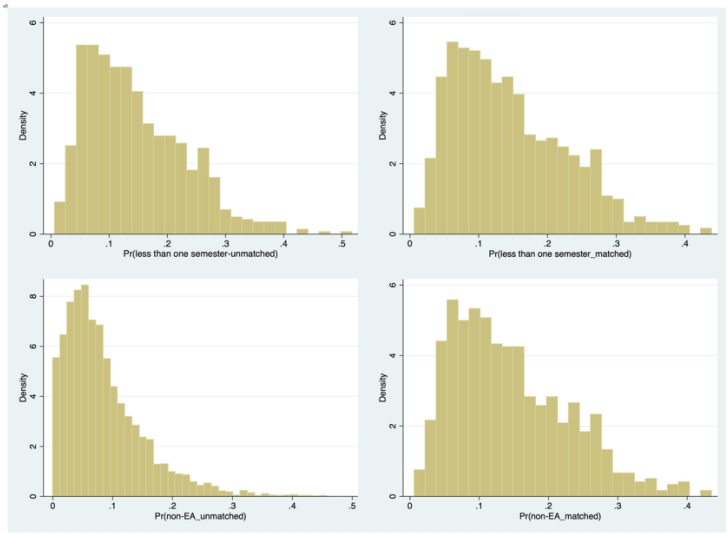

Figure 3.7 Histograms of propensity scores for EA less than one semester and non-EA before and after matching

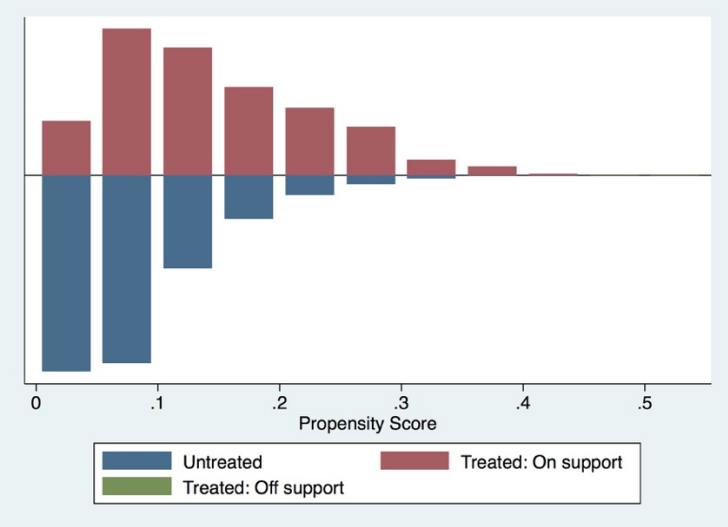

Figure 3.8 Common support of propensity scores between EA less than one semester and non-EA after matching

Table 2.2 presents the covariates balance results before and after PSM between students who studied abroad for one semester and students who did not study abroad. Before matching, there was a statistically significant mean difference of the propensity scores between the two groups and the standardized bias was 106.5%, indicating that average probabilities of studying

Table 3.5 Covariates Balance Results Before and After PSM between EA Equal to One Semester (*n*=233) and Non-EA

	Before Matching				After Matching					
	EA	Non-EA	[1]Diff	SB (%)	EA	Non-EA	SD	Diff	SB (%)	Reduction (%)
Propensity score	0.074	0.025	0.049***	106.5	0.073	0.073	0.073	0	0	100
URM	0.119	0.124	-0.005	-1.3	0.120	0.107	0.317	0.013	3.9	-206.8
Male	0.286	0.498	-0.212***	-44.5	0.287	0.330	0.426	-0.043	-9.0	79.8
First-generation	0.081	0.191	-0.110***	-32.5	0.082	0.073	0.267	0.009	2.5	92.2
Foreign language	0.141	0.064	0.077***	25.5	0.142	0.167	0.361	-0.025	-8.5	66.5
1st-year Pell Grant	0.162	0.252	-0.090**	-22.0	0.163	0.189	0.381	-0.026	-6.4	71.0
1st-year GPA	3.493	2.830	0.663***	89.0	3.490	3.467	3.479	0.023	3.1	96.5
College readiness	51.827	48.514	3.313***	56.1	51.784	51.723	51.754	0.061	1.0	98.2
Advanced hours	8.632	4.559	4.073***	39.2	8.451	7.983	8.220	0.468	4.5	88.5

Note. [1]For categorical independent variables, the differences in proportions were reported. Two-sample proportion tests were conducted. For continuous independent variables, the differences in means were reported. Two-sample t-tests were conducted.

* P ≤ .05. **P ≤ .01. ***P ≤ .001.

abroad for one semester were very different between the two groups. After matching, the mean difference was no longer statistically significant. Overall, the percentage of bias reduction was 100%, suggesting a significant bias reduction by PSM. Additionally, some statistically significant differences between the two groups before matching were no longer significant after matching. Figure 2d visually indicates that the standardized bias decreased significantly across all covariates after matching. The distributions of the two matched groups were much more comparable than those of the unmatched groups, as indicated in Figure 2e. Most of the treated students were matched with untreated students with a similar propensity score. 1 out of 233 students who studied abroad for one semester were off support. The characteristics of this student are presented in Appendix Table A.

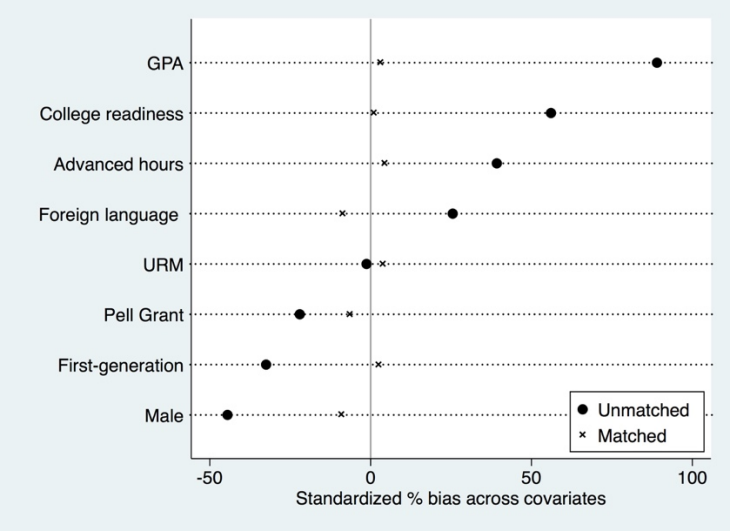

Figure 3.9 Standardized bias across covariates before and after matching for EA equal to one semester

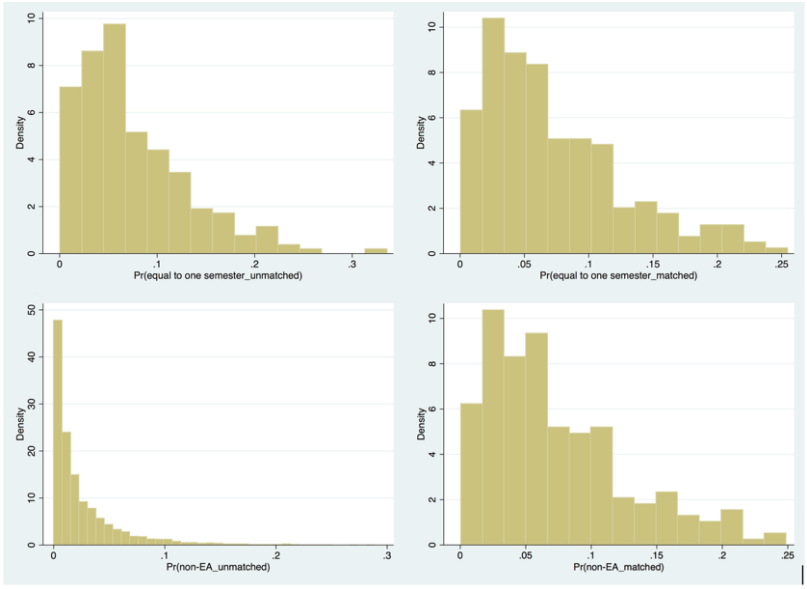

Figure 3.10 Histograms of propensity scores for EA equal to one semester and non-EA before and after matching

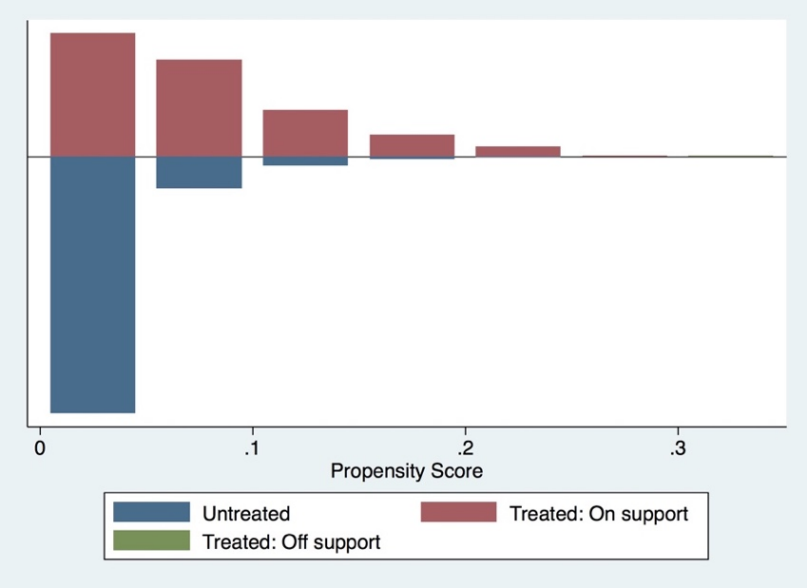

Figure 3.11 Common support of propensity scores between EA equal to one semester and non-EA after matching

Table 2.3 presents the covariates balance before and after PSM between students who studied abroad for more than one semester and students who did not study abroad. Before matching, the mean difference of the propensity scores between the two groups was 0.013 with a

standardized bias of 108%. After matching, there was no mean difference in propensity score between the two groups. Overall, there was a 100% bias reduction by all eight covariates. In addition, none of the differences between the two groups across eight covariates remained statistically significant after matching. The standardized bias also decreased significantly across all covariates after matching, as indicated in both Table 2.3 and Figure 2g. The distributions of propensity scores for the matched groups were much more similar to each other than the distributions prior to matching, as indicated in Figure 2h. Figure 2i provides the common support for the range of propensity scores across the two groups. All treated students were matched with untreated students with a similar propensity score.

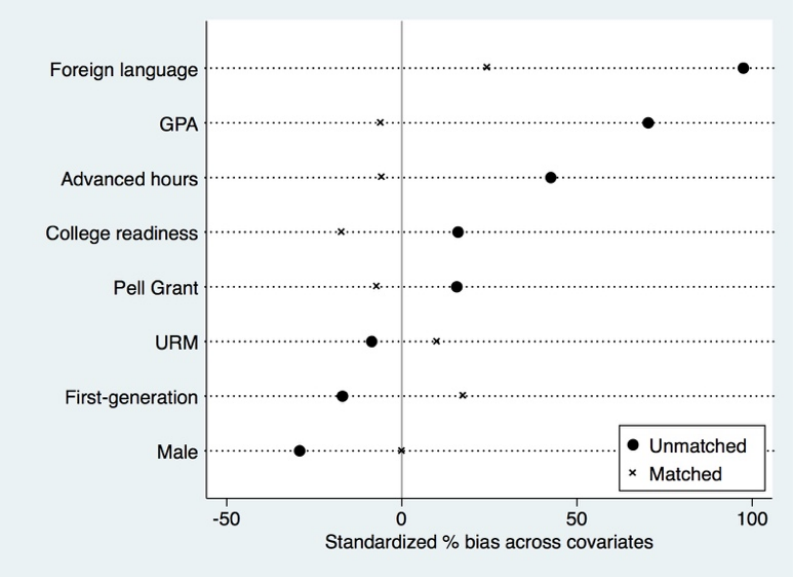

Figure 3.12 Standardized bias across covariates before and after matching for EA more than one semester

Table 3.6 Covariates Balance Results Before and After PSM between EA More than One Semester (*n*=31) and Non-EA

	Before Matching				After Matching				
	EA	Non-EA	[1]Diff	SB (%)	EA	Non-EA	Diff	SB (%)	Reduction (%)
Propensity Score	0.016	0.003	0.013***	108	0.016	0.016	0	0	100
URM	0.097	0.124	-0.027	-8.6	0.097	0.065	0.032	10.2	-19.1
Male	0.355	0.499	-0.144	-29.1	0.355	0.355	0	0	100
First-generation	0.129	0.191	-0.062	-16.9	0.129	0.065	0.064	17.5	-3.6
Foreign language	0.452	0.064	0.388***	97.5	0.452	0.355	0.097	24.3	75.0
1st-year Pell Grant	0.323	0.251	0.072	15.7	0.323	0.355	-0.032	-7.1	54.8
1st-year GPA	3.367	2.831	0.536**	70.3	3.367	3.412	-0.045	-5.9	91.6
College readiness	49.516	48.514	1.002	16.1	49.516	50.587	-1.071	-17.2	-6.8
Advanced hours	8.193	4.568	3.635*	42.5	8.193	8.677	-0.484	-5.7	86.7

Note. [1]For categorical independent variables, the differences in proportions were reported. Two-sample proportion tests were conducted. For continuous independent variables, the differences in means were reported. Two-sample t-tests were conducted.

*P ≤ .01. **P ≤ .001.

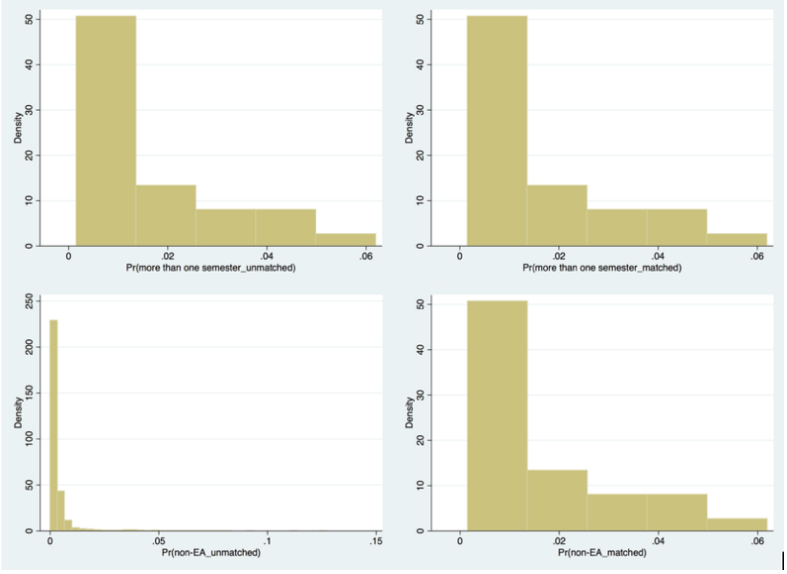

Figure 3.13 Histograms of propensity scores for EA equal to one semester and non-EA before and after matching

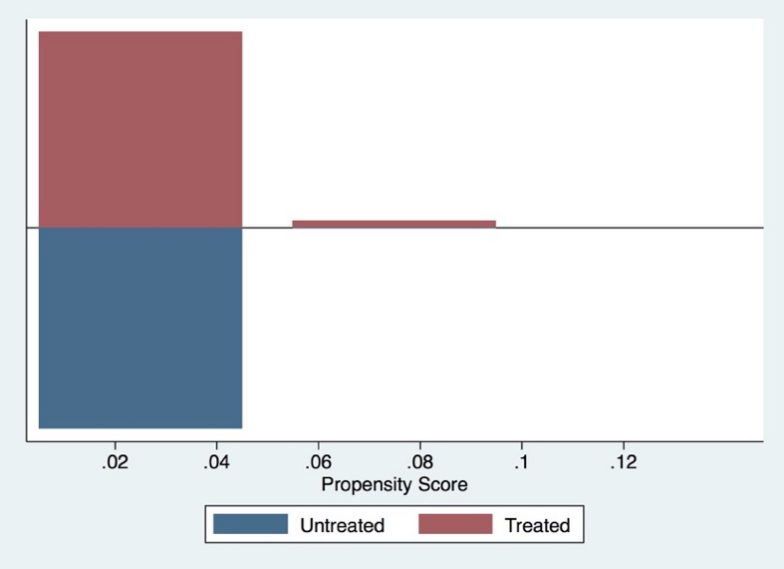

Figure 3.14 Common support of propensity scores between EA equal to one semester and non-EA after matching

3.5.2.2 Treatment Effect Estimates

After controlling for the covariates and including the cohort and college fixed effects, students who studied abroad for less than one semester were more likely to graduate within four

years than students who did not study abroad, as indicated in Table 2.4. Additionally, there were no statistically significant differences in 4-year graduation rates found between students who studied abroad for one semester and students who did not study abroad, and between students who studied abroad for more than one semester and students who did not study abroad. The result on the matched sample after PSM indicates that students who studied abroad for less than one semester were 1.359 times as likely to graduate within four years as students who did not study abroad. While holding covariates at their means, the probabilities of graduating within four years for students who did not study abroad and students who studied abroad less than one semester, one semester and more than semester were respectively 48.8%, 56.3%, 53.7% and 45.9%, as indicated in Figure 2j. The post hoc tests did not find any statistically significant difference between the following comparison groups: less than one semester vs. one semester, less than one semester vs. more than one semester, and one semester vs. more than one semester.

Table 3.7 (continued) The Impact of Duration of Education Abroad on 4-Year Graduation Rate

4-Year Graduation					
	Before PSM				After PSM
	Model 1	Model 2	Model 3	Model 4	Model 5
Less than one semester	2.551*	1.612*	1.609*	1.442*	1.349*
	(0.197)	(0.135)	(0.135)	(0.127)	(0.146)
One semester	3.088*	1.561*	1.562*	1.198	1.217
	(0.420)	(0.225)	(0.225)	(0.181)	(0.201)
More than one semester	2.037	1.229	1.230	1.041	0.889
	(0.722)	(0.476)	(0.476)	(0.428)	(0.365)
[1]Covariates	NO	YES	YES	YES	YES
Cohort fixed effects	NO	NO	YES	YES	YES
College fixed effects	NO	NO	NO	YES	YES

N (total)	8,250	8,225	8,225	8,225	1,982
Pseudo R^2	0.020	0.153	0.153	0.222	0.140
Log-likelihood	-5278.962	-4546.033	-4545.863	-4178.821	-1177.616
AIC	10565.924	9116.066	9117.731	8409.642	2405.231
BIC	20593.996	9200.245	9208.925	8592.031	2545.027

Note. [1]Covariates included gender, URM, first-year Pell Grant, first-generation, advanced hours accepted, first-year GPA, first-year foreign language experience, and college readiness.

Robust standard errors are in parentheses.

*P ≤ .0083

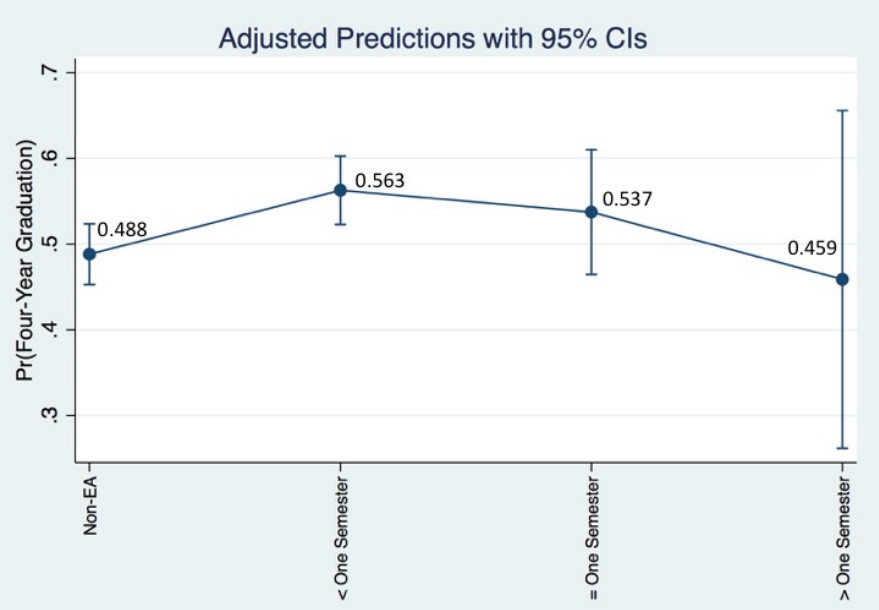

Figure 3.15 The average predicted probabilities of 4-year graduation for different durations of education abroad

There were statistically significant differences in 6-year graduation rates between student who studied abroad for less than one semester and students who did not study abroad, and between students who studied abroad for one semester and students who did not study abroad, after controlling for the covariates and including the cohort and college fixed effects, as indicated in Table 2.5. No statistically significant difference in 6-year graduation rates was found between students who studied abroad for more than one semester and students who did not study abroad.

The results on the matched sample after PSM indicate that students who studied abroad for less than one semester were 2.852 times as likely to graduate within six years as students who did not study abroad, and students who studied abroad for one semester were 3.476 times as likely to graduate within six years as students who did not study abroad. On average, students who did not study abroad had a 75.3% chance of graduating within six years, a student who studied abroad for less than one semester had a 89.7% percent chance, a student who studied for one semester had a 91.4% chance, and a student who studied for more than one semester had a 85.2% chance, as indicated in Figure 2k. The post hoc tests did not find any statistically significant difference in 6-year graduation between the following comparison groups: less than one semester vs. one semester, less than one semester vs. more than one semester, and one semester vs. more than one semester.

Table 3.8 (continued) The Impact of Duration of Education Abroad on 6-Year Graduation Rate

6-Year Graduation					
	Before PSM				After PSM
	Model 1	Model 2	Model 3	Model 4	Model 5
Less than one semester	4.670*	3.108*	3.105*	3.307*	2.852*
	(0.494)	(0.354)	(0.354)	(0.423)	(0.423)
One semester	7.261*	3.681*	3.683*	3.784*	3.476*
	(1.604)	(0.850)	(0.851)	(0.969)	(0.949)
More than one semester	3.430*	2.280	2.283	2.335	1.879
	(1.555)	(1.096)	(1.098)	(1.244)	(1.010)
[1]Covariates	NO	YES	YES	YES	YES
Cohort fixed effects	NO	NO	YES	YES	YES
College fixed effects	NO	NO	NO	YES	YES
N (total)	8,250	8,225	8,225	8,222	1,955
Pseudo R^2	0.036	0.211	0.211	0.325	0.225

Log-likelihood	-5363.640	-4374.451	-4373.386	-3744.781	-766.319
AIC	10735.281	8772.902	8774.772	7539.561	1580.638
BIC	10763.353	8857.081	8865.967	7714.925	1714.513

Note. [1]Covariates included gender, URM, first-year Pell Grant, first-generation, advanced hours accepted, first-year GPA, first-year foreign language experience, and college readiness.

Robust standard errors are in parentheses.

*P ≤ .0083

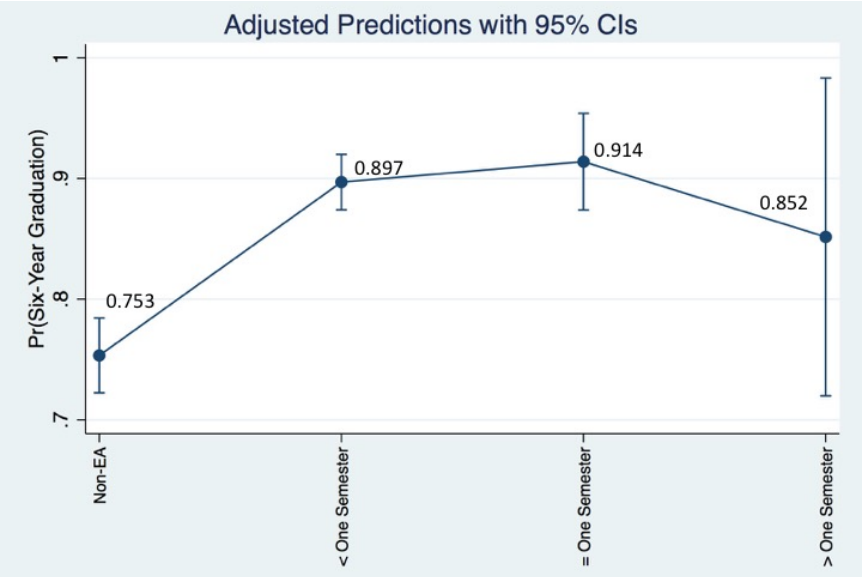

Figure 3.16 The average predicted probabilities of 6-year graduation for different durations of education abroad

3.5.3 Number of Education Abroad Experiences

3.5.3.1 PSM Results

As to the number of education abroad experiences, I used multinomial logistic regression models to predict the propensity score for each of the two treatment categories: one time abroad and more than one time abroad. I matched the treated students from each treatment category with untreated students separately based on the propensity scores. Table 3.1 presents the covariates balance results before and after matching between students who participated in education abroad

one time and students who did not participate in education abroad. Before matching, there was a statistically significant mean difference of the propensity scores between the two groups and the standardized bias was 83.7%, indicating that average probabilities of participating in education abroad for one time were very different between the two groups. Overall, there was a 100% bias reduction by all eight covariates. In addition, none of the differences between the two groups across eight covariates remained statistically significant after matching. Figure 3a visually indicates that the standardized bias decreased significantly across all covariates after matching. The distributions of the two matched groups were much more comparable than those of the unmatched groups, as indicated in Figure 3b. Most of the treated students were matched with untreated students with a similar propensity score. 1 out of 890 students who studied abroad for one time were off support. The characteristics of these two students are presented in Appendix Table A.

Table 3.9 Covariates Balance Results Before and After PSM between One EA Experience (*n*=890) and Non-EA

	Before Matching				After Matching				
	EA	Non-EA	[1]Diff	SB (%)	EA	Non-EA	Diff	SB (%)	Reduction (%)
Propensity Score	0.171	0.099	0.072***	83.7	0.169	0.169	0	0	100
URM	0.149	0.124	0.025*	7.2	0.148	0.159	-0.011	-3.0	59.1
Male	0.310	0.499	-0.189***	-39.2	0.310	0.299	0.011	2.3	94.0
First-generation	0.123	0.191	-0.068***	-18.9	0.123	0.136	-0.013	-3.7	80.3
Foreign language	0.134	0.064	0.070***	23.5	0.134	0.138	-0.004	-1.1	95.2
1st-year Pell Grant	0.171	0.251	-0.080***	-19.7	0.171	0.178	-0.007	-1.7	91.5
1st-year GPA	3.332	2.831	0.501***	64.2	3.332	3.311	0.021	2.6	95.9
College readiness	50.481	48.514	1.967***	32.2	50.471	50.368	0.103	1.7	94.7
Advanced hours	6.898	4.568	2.330***	23.8	6.884	6.927	-0.043	-0.4	98.2

Note. [1]For categorical independent variables, the differences in proportions were reported. Two-sample proportion tests were conducted. For continuous independent variables, the differences in means were reported. Two-sample t-tests were conducted.

*P ≤ .01. **P ≤ .001.

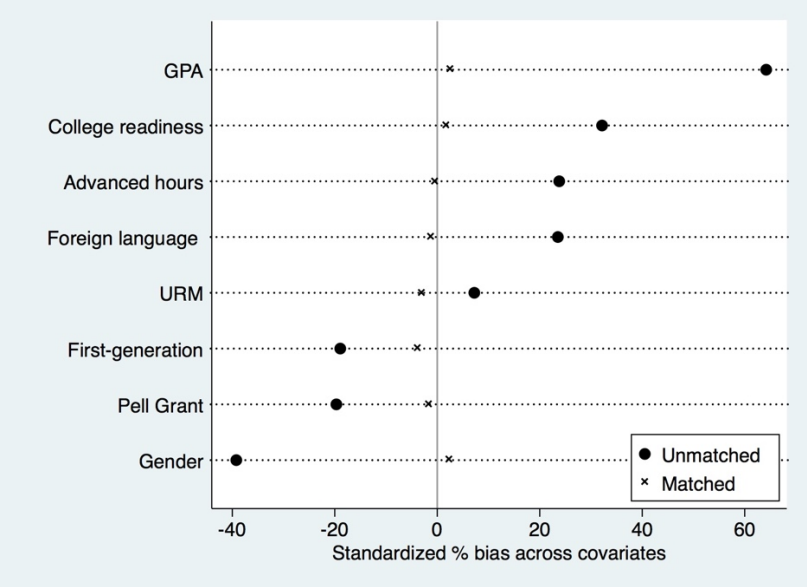

Figure 3.17 Standardized bias across covariates before and after matching for one EA experience

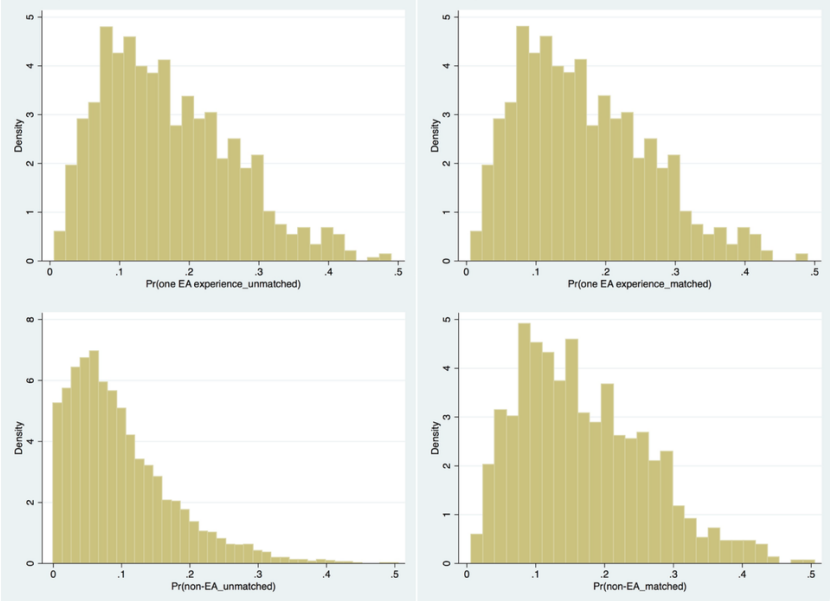

Figure 3.18 Histograms of propensity scores for one EA experience and non-EA before and after matching

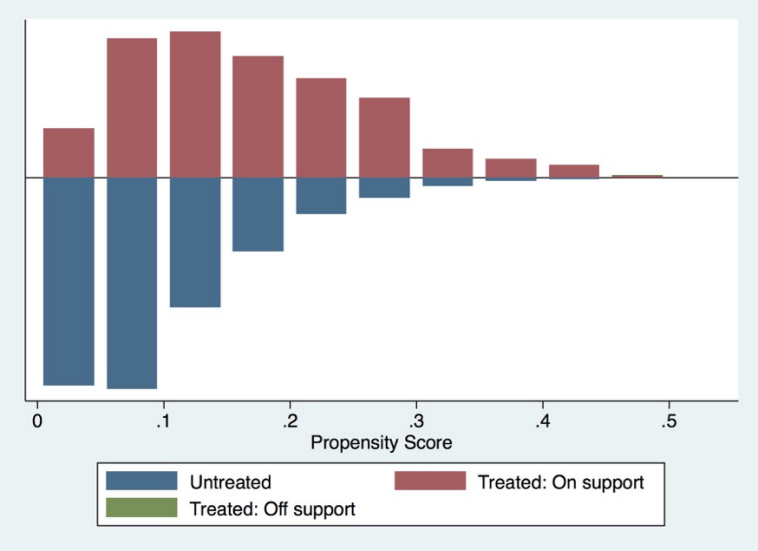

Figure 3.19 Common support of propensity scores between one EA experience and non-EA after matching

Table 3.2 presents the covariates balance results before and after matching between students who participated in education abroad for more than one time and students who did not participate in education abroad. Before matching, the mean difference of the propensity scores between the two groups was 0.035 with a standardized bias of 106.4%. After matching, there was no mean difference in propensity score between the two groups. Overall, there was a 100% bias reduction by all eight covariates. Additionally, the statistically significant differences across some of the covariates existed before matching were no longer significant after matching. The standardized bias also decreased significantly across all covariates after matching, as indicated in both Table 3.2 and Figure 3d. The distributions of propensity scores for the matched groups were much more similar to each other than the distributions prior to matching, as indicated in Figure 3e. Figure 3f provides the common support for the range of propensity scores across the two groups. All treated students were matched with untreated students with a similar propensity score.

Table 3.10 Covariates Balance Results Before and After PSM between More than One EA Experience (*n*=135) and Non-EA

	Before Matching				After Matching				
	EA	Non-EA	[1]Diff	SB (%)	EA	Non-EA	Diff	SB (%)	Reduction (%)
Propensity Score	0.049	0.014	0.035***	106.4	0.049	0.049	0	0	100
URM	0.214	0.124	0.090*	24.2	0.215	0.215	0	0	100
Male	0.281	0.499	-0.218***	-45.6	0.281	0.281	0	0	100
First-generation	0.119	0.191	-0.072*	-20.2	0.119	0.148	-0.029	-8.2	59.3
Foreign language	0.178	0.064	0.114***	35.3	0.178	0.133	0.045	13.8	60.9
1st-year Pell Grant	0.230	0.251	-0.021	-5.0	0.230	0.215	0.015	3.5	31.3
1st-year GPA	3.530	2.831	0.699***	94.2	3.530	3.569	-0.039	-5.2	94.4
College readiness	52.067	48.514	3.553***	56.1	52.067	52.332	-0.265	-4.2	92.5
Advanced hours	12.237	4.568	7.669***	67.4	12.237	13.141	-0.907	-7.9	88.2

Note. [1]For categorical independent variables, the differences in proportions were reported. Two-sample proportion tests were conducted. For continuous independent variables, the differences in means were reported. Two-sample t-tests were conducted.

*P ≤ .01. **P ≤ .001.

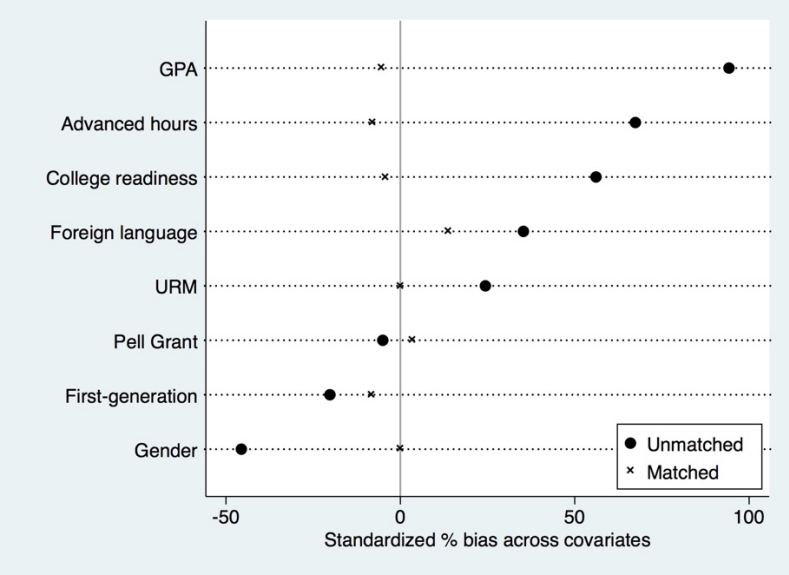

Figure 3.20 Standardized bias across covariates before and after matching for more than one EA experience

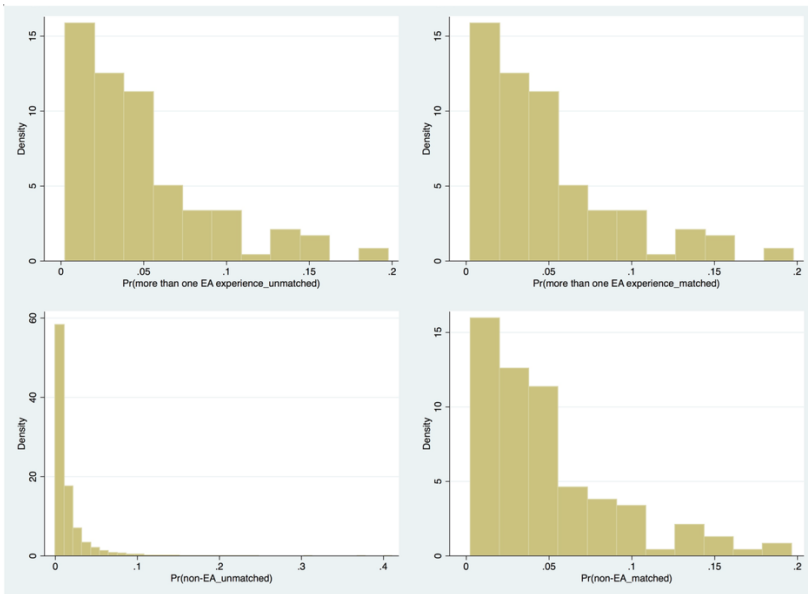

Figure 3.21 Histograms of propensity scores for more than one EA experience and non-EA before and after matching

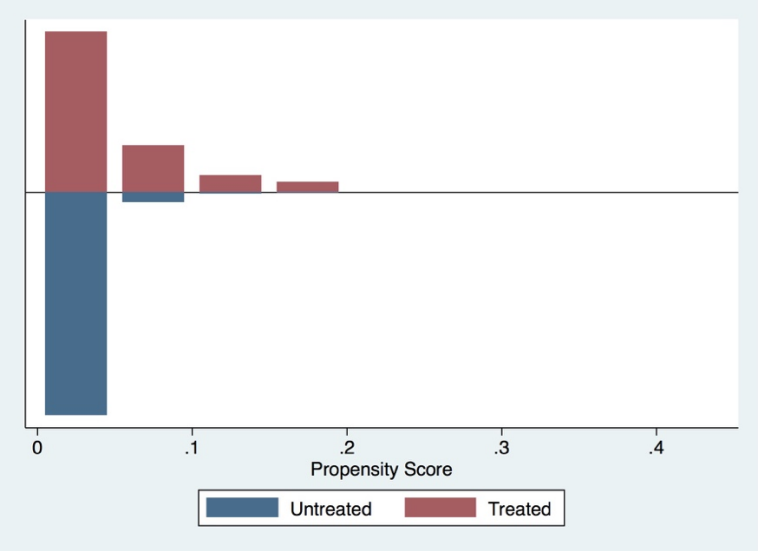

Figure 3.22 Common support of propensity scores between more than one EA experience and non-EA groups after matching

3.5.3.2 Treatment Effect Estimates

After controlling for the covariates and including the cohort and college fixed effects, students who had one education abroad experience were more likely to graduate within four years than students who had no education abroad experience, as indicated in Table 2.4. Additionally, there were no statistically significant differences in 4-year graduation rates found between students who had more than one education abroad experience and students who had no education abroad experience. The result on the matched sample after PSM indicates that students who had one education abroad experience were 1.413 times as likely to graduate within four years as students who had no education abroad experience. While holding covariates at their means, the probabilities of graduating within four years for students who had no education abroad experience, one education abroad experience, and more than one education abroad experience were respectively 48.1%, 56.7%, and 43.6%, as indicated in Figure 3g. Additionally, the post hoc test found there was a statistically significant difference between students who had one education abroad experience and students who had more than one education abroad experience. On average, students

who had one education abroad experience were 1.692 times as likely to graduate within four years as students who had more than one education abroad experience.

Table 3.11 The Impact of Number of Education Abroad Experience on 4-Year Graduation Rates

4-Year Graduation					
	Before PSM				After PSM
	Model 1	Model 2	Model 3	Model 4	Model 5
One time	2.746*	1.705*	1.703*	1.473*	1.413*
	(0.198)	(0.134)	(0.133)	(0.122)	(0.145)
More than one time	2.067*	0.983	0.982	0.837	0.835
	(0.360)	(0.182)	(0.182)	(0.164)	(0.170)
[1]Covariates	NO	YES	YES	YES	YES
Cohort fixed effects	NO	NO	YES	YES	YES
College fixed effects	NO	NO	NO	YES	YES
N (total)	8,250	8,225	8,225	8,225	2,008
Pseudo R^2	0.020	0.154	0.154	0.222	0.137
Log-likelihood	-5278.861	-4542.338	-4542.163	-4175.933	-1198.388
AIC	10563.722	9106.676	9108.327	8401.865	2444.776
BIC	10584.776	9183.840	9192.506	8577.238	2579.294

Note. [1]Covariates included gender, URM, first-year Pell Grant, first-generation, advanced hours accepted, first-year GPA, first-year foreign language experience, and college readiness.

Robust standard errors are in parentheses.

*P ≤ .0167

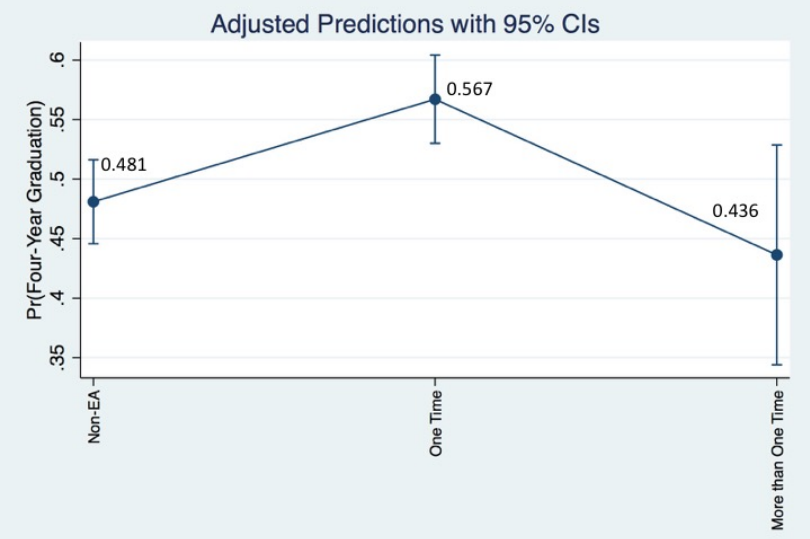

Figure 3.23 The average predicted probabilities of 4-year graduation for different numbers of education abroad experience

As indicated in Table 3.4, the results on the matched sample after PSM indicate that students who had one education abroad experience were 3.596 times as likely to graduate within six years as students who had no education abroad experience, and students who had more than one education abroad experience were 3.442 times as likely to graduate within six years as students who had no education abroad experience. While holding covariates at their means, the probabilities of graduating within six years for students who had no education abroad experience, one education abroad experience, and more than one education abroad experience were respectively 72.5%, 90.5%, and 90.1%, as indicated in Figure 3h. The post hoc test did not find any statistically significant difference in 6-yeargraduation rates between students who had on education abroad experience and students who had more than one education abroad experience.

Table 3.12 The Impact of Number of Education Abroad Experience on 6-Year Graduation Rates

6-Year Graduation					
	Before PSM				After PSM
	Model 1	Model 2	Model 3	Model 4	Model 5
One time	5.030*	3.262*	3.260	3.397*	3.596*
	(0.506)	(0.354)	(0.354)	(0.412)	(0.517)
More than one time	5.144*	2.611*	2.608*	3.034*	3.442*
	(1.308)	(0.693)	(0.692)	(0.902)	(1.095)
[1]Covariates	NO	YES	YES	YES	YES
Cohort fixed effects	NO	NO	YES	YES	YES
College fixed effects	NO	NO	NO	YES	YES
N (total)	8,250	8,225	8,255	8,222	2,008
Pseudo R^2	0.036	0.211	0.211	0.325	0.246
Log-likelihood	-5365.763	-4374.613	-4374.548	-3745.060	-791.443
AIC	10737.526	8771.226	8773.096	7538.119	1630.886
BIC	10758.580	8848.390	8857.275	7706.469	1765.404

Note. [1]Covariates included gender, URM, first-year Pell Grant, first-generation, advanced hours accepted, first-year GPA, first-year foreign language experience, and college readiness.

Robust standard errors are in parentheses.

*P ≤ .0167

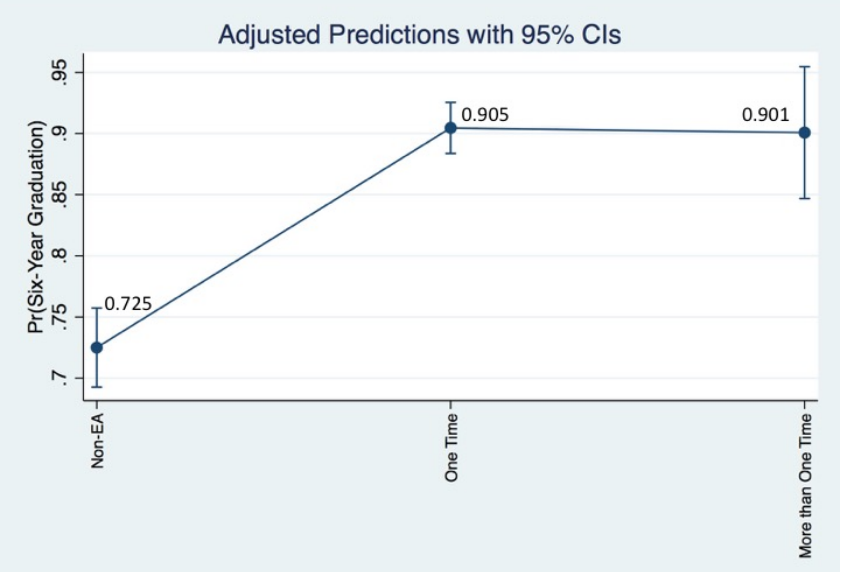

Figure 3.24 The average predicted probabilities of 6-yeargraduation for different numbers of education abroad experience

3.6 Conclusions

As participation in education abroad increases rapidly, a need to supply evidence of the effects of education abroad on student success through rigorous and critical research is growing. While researchers have investigated the effects of participation in education abroad on college completion, few studies have addressed a threat to internal validity—selection bias—existed within the research field of education abroad (CASSIE, 2017). Thus, selecting a comparison group that shares similar likelihood to participate in education abroad with the treatment group at the baseline is a key step for education abroad assessment research. In order to reduce the effects of selection bias, this study employed a statistical technique—propensity score matching (PSM)—to select comparison groups that share similar likelihood to receive a treatment with treatment groups based on all observed characteristics. Through addressing the methodological limitations and literature gaps, this study investigated three relationships: the relationship between participation in education abroad and college completion, the relationship between the duration of education

abroad and college completion, and the relationship between the number of education abroad experiences and college completion. PSM was used not only to select a comparable group for participation in education abroad but also to select comparable groups for different durations of education abroad and different numbers of education abroad experiences. In addition, this study included cohort and college fixed effects to account for any unobserved characteristics across cohorts and colleges.

The results of this study confirm and extend previous studies. The results support the findings that students who participated in education abroad were more likely to graduate within four years or six years (O'Rear, Sutton, & Rubin, 2012; Sutton & Rubin, 2010; Malmgren & Calvin, 2008; Xu et al., 2013; Hamir, 2011). Results after PSM indicate that students who participated in education abroad were 1.348 times as likely to graduate within four years and 3.475 times as likely to graduate within six years as students who did not participate in education abroad (See Table 1.2 & 1.3). Previous studies did not examine the relationship between variations of education abroad and college completion using any matching approach. Employing PSM to select a comparable group for each treatment category and using the Bonferroni adjustment for multiple comparisons, this study further explored the effects of different education abroad programs and experiences on 4-year and 6-year graduation.

For different durations of education abroad, results on the matched sample after PSM indicate that students who studied abroad for less than one semester were 1.359 times as likely to graduate within four years as students who did not study abroad (See Table 2.4). There were no statistically significant differences in 4-year graduation rates found among other comparison groups. In terms of 6-year graduation rates, the results on the matched sample after PSM indicate that students who studied abroad for less than one semester were 2.852 times as likely to graduate

within six years as students who did not study abroad, and students who studied abroad for one semester were 3.476 times as likely to graduate within six years as students who did not study abroad (See Table 2.5). No other statistically significant differences in 6-year graduation rates were found among other comparison groups. In sum, compared with no participation in education abroad, participation in an education abroad program that was less than one semester positively impacted 4-year graduation rates, and participation in an education abroad program that was equal to or less than one semester positively impacted 6-year graduation rates. Nevertheless, it is important to note that participation in an education abroad program that was more than one semester did not differ in college completion rates from no education abroad. Despite the concerns that participation in education abroad, especially for more than one semester, may take students more time to graduate from college, the findings suggest that it is not an issue directly.

For different numbers of education abroad experiences, the results after PSM indicate students who had one education abroad experience were 1.413 times as likely to graduate within four years as students who had no education abroad experience (See Table 3.3), and students who had one education abroad experience were 1.692 times as likely to graduate within four years as students who had more than one education abroad experience. As to 6-year graduation rates, the results on the matched sample after PSM indicate that students who had one education abroad experience were 3.596 times as likely to graduate within six years as students who had no education abroad experience, and students who had more than one education abroad experience were 3.442 times as likely to graduate within six years as students who had no education abroad experience. No other statistically significant differences in 4-year or 6-year graduation rates were found among other comparison groups. Overall, compared with no education abroad experience, having one education abroad experience had the most positive impact on 4-year and 6-year

graduation rates. It is important to note that having one education abroad experience does not significantly differ from having more than one education abroad experience in 6-year graduation rates.

The findings in this study confirm that participation in education abroad identified as one of the high impact practices (Kuh, 2008) leads to student success, measured as 4-year and 6-year graduation rates. Compared with 4-year graduation rates, the differences between comparison groups were greater in 6-year graduation rates. In other words, having some education abroad experiences had a greater impact on 6-year graduation rates. The conceptual framework outlined the importance of student engagement in student success (Tinto, 1975, 1987; Astin, 1984; Kuh, 2008). The findings of this study may suggest the meditating effect of student engagement on the relationship between education abroad and college completion. In addition, this study found that participation in education abroad that was less than or equal to one semester had the biggest impact on college completion, compared with no education abroad participation. This finding suggests that short-term education abroad has the most added value on college completion, in addition to its flexibility and affordability. Compared with no education abroad experience and more than one education broad experience, having one education abroad experience had the greatest impact on 4-year graduation rates. Having one or more than one education abroad experience positively impacted the 6-year graduation rates compared with no education abroad experience. This finding again emphasizes the importance of having some education abroad experience on student success and suggests that education abroad may serve as an effective approach to increase college graduation rates.

Through addressing methodological limitations in the literature, this study empirically demonstrates that education abroad can impact college completion. Moreover, this study also

employed matching processors to explore the effects of different types of education abroad on college completion. In this way, this study encourages researchers to use advanced matching methods to reduce selection bias while assessing the education abroad outcomes.

3.7 Discussion

The findings of this study lead to a number of important insights for education abroad professionals and policy makers who advocate for participation in education abroad, as well as for education abroad scholars to understand the relationship between education abroad and college completion from an advanced methodological perspective. This section presents and elaborates several important implications, addresses the limitations of the study, and discusses several directions for future research steps.

First, despite the concerns that participation in education abroad may take students more time to graduate from college, the findings of this study support that participation in education abroad – one of the high-impact practices – can promote student success, in terms of college completion. Thus, it is important for public policy makers to support colleges and universities in their efforts to make participation in education abroad accessible and affordable. Colleges and universities should exert great efforts to increase education abroad opportunities and integrate more education abroad programs into their regular curriculum. Second, this study found that short-term education abroad programs had greater effects on college completion than other types of education abroad programs. In general, short-term education abroad programs are more affordable than longer programs and are more flexible, especially for students in structured academic programs like engineering and nursing to study abroad without falling behind in their programs. Therefore, promoting participation in short-term education abroad programs and ensuring their

quality is critical. Providing financial support, such as education abroad scholarships, can encourage participation of students from low-income families. Integrating short-term education abroad programs into regular curriculum through the collaborations of education abroad professionals and faculty is another practice to increase students' participation in short-term education abroad programs.

Although PSM helps increase the internal validity of education abroad research by minimizing the selection bias, this study itself by no means implies that there is a causal relationship between education abroad and college completion. First, using PSM to match education abroad and non-education abroad participants based on their similar propensity scores relies upon the strong assumption that the selection process is well explained by observable characteristics within the propensity score model. Even though this study included all observable variables that were available in the data set to predict the propensity scores, some other potential observed and unobserved characteristics affecting students' likelihood to study abroad still exist, for example, students' intent towards education abroad, students' openness to diverse ideas and people, their interests in cross-cultural experiences, etc. Second, after being matched, the sample size decreases. The findings of this study can only be generalized to a population of students sharing similar observable characteristics, which decreases the external validity of this study.

This study used a greedy matching approach—nearest neighbor matching within a caliper—to select comparable comparison groups for each treatment. Users of this approach can encounter a dilemma between incomplete matching and inaccurate matching (Rosenbaum, 2002; Parsons, 2001). To solve the problem within the conventional framework of propensity score matching, the recommended procedure for future research is to test different propensity score prediction models and conduct sensitivity analyses by varying the size of the common support

region (Guo & Fraser, 2015). This present study did not examine the varied effects of participation in education abroad across subgroups, such as URM students, first-generation students, etc. Thus, an extension to this study could be to examine whether participation in education has a bigger impact on college completion for students from less advantaged subgroups. This study used a data set that was collected within a single four-year public institution. A final direction for future research is to explore the effects of education abroad on student success across different types of institutions. By taking institutional level characteristics into account, future research will be able to examine how the effects of education abroad varies across institution.

APPENDICES

APPENDIX 1. CHARATERISTICS OF TREATED STUDENTS OFF SUPPORT (A) AND MATCHED TREATED (B) AND UNTREATED (C) STUDENTS

	Participation in EA			EA < One Semester			EA = One Semester			One EA Experience		
	A	B	C	A	B	C	A	B	C	A	B	C
	(6)	(1,017)	(1,017)	(2)	(756)	(756)	(1)	(233)	(233)	(1)	(887)	(887)
Propensity Score	0.633	0.203	0.204	0.495	0.145	0.146	0.336	0.073	0.073	0.466	0.169	0.169
URM	0.500	0.155	0.153	100	0.169	0.180	0	0.120	0.107	0	0.149	0.159
Male	0	0.308	0.318	0	0.311	0.319	0	0.287	0.330	0	0.310	0.299
First-generation	0.000	0.123	0.112	0	0.135	0.148	0	0.082	0.073	0	0.123	0.136
Foreign language	0.667	0.137	0.146	100	0.124	0.131	0	0.142	0.167	100	0.134	0.138
1st-year Pell Grant	0	0.180	0.151	0	0.179	0.171	0	0.163	0.189	0	0.171	0.178
1st-year GPA	0	3.355	3.348	3.900	3.315	3.300	4.000	3.490	3.467	3.903	3.332	3.311
College readiness	54.683	50.666	50.473	51.300	50.385	50.208	61.800	51.784	51.723	59.000	50.471	50.368
Advanced hours	22.500	7.514	7.520	18.500	7.230	6.783	51.000	8.451	7.983	19.000	6.884	6.927

Note. The numbers of students are in parentheses.

CHAPTER 4. USING A NATIONAL LONGITUDINAL STUDY TO UNDERSTAND THE PARTICIPATION AND EFFECTS OF EDUCATION ABROAD

4.1 Introduction

The Association of American Colleges and Universities (AAC&U) identified a number of high-impact practices to be effective in cultivating student learning, enhancing academic engagement, and preparing students for future careers (Kuh, 2008). In recent years, these high-impact practices have been widely promoted and adopted by colleges and universities in order to improve student learning and increase college completion. As one of the high-impact practices, education abroad has been found to be a positive factor that boosts college completion (Malmgren & Calvin, 2008; Hamir, 2011; O'Rear, Sutton, & Rubin, 2012; Xu, Silva, Neufeldt, & Dane, 2013; Kim, 2017). However, much of the existing education abroad research has predominately been institution specific and small scale (Ogden & Streitwieser, 2016). While there is arguably a case for theoretical generalizability, research results generated from a single institution setting cannot be broadly generalizable to the field of US education abroad. On the contrary, the findings can only be applied to institutions who share similar characteristics in terms of institution type, selectivity, education broad policy, financial structure, university resources settings, etc. Furthermore, little research has been conducted at the institution-level to understand how institutional settings and characteristics might influence students' participation in education abroad and impact further broader outcomes.

There have been empirical students that have investigated the relationship between participation in education abroad and college completion (Johnson & Stage, 2018; Malmgren &

Calvin, 2008; Hamir, 2011; O'Rear, Sutton, & Rubin, 2012; Xu, Silva, Neufeldt, & Dane, 2013). However, none of them have provided empirical evidence by reducing selection bias, which is considered a threat to internal validity within the field of international education research (Haupt, Ogden, & Rubin, 2018; Consortium for Analysis of Student Success through International Education [CASSIE], 2017). Additionally, none of the studies discussed the inclusion of institution-level characteristics to address the selection bias, as different institutional settings could affect students' likelihood to participate in education abroad.

Through addressing the gap in the literature, this study is unique in its attention to its use of national data and its attention to the participation and effects of education abroad on multiple college campuses. With this study, I explored the influence of both student-level and institution-level characteristics on students' participation in education abroad and then examined the effects of education abroad on bachelor's degree attainment across multiple institutions by answering the following two research questions:

- What are the association between both student- and institution-level characteristics on students' participation in education abroad?
- What is the effect of education abroad on bachelor's degree attainment across multiple institutions?

4.2 Relevant Literature

4.2.1 Participation in Education Abroad

A few studies have explored the association between student-level characteristics and students' participation in education abroad. In terms of demographic characteristics, researchers found

female and white students were more likely to participate in education than their male and minority counterparts (Salisbury, Paulsen, & Pascarella, 2010, 2011; Dessoff, 2006; Stroud, 2010; Simon & Ainsworth, 2012). Studies found that the low socioeconomic status of a student's family served as barrier to participation in education abroad (Booker, 2001; Simon &Ainsworth, 2012). A series of academic factors also appeared to influence students' education abroad attitudes and decisions, such as high school grade point average (GPA), Scholastic Assessment Test (SAT), or American College Testing (ACT), etc. (Paus & Robinson, 2008; Luo & Jamieson-Drake, 2015; Salisbury et al., 2010, 2011; Thomas & McMahon, 1998). Studies also noted that the differences in attitudes, interests, affective traits, and certain behaviors could influence students' decisions and attitudes toward education abroad (Rust et al., 2008; Salisbury et al., 2009; Simon & Ainsworth, 20012; Stroud, 2010; Goldstein & Kim, 2016; Carlson, Burn, & Yachimowicz, 1990). Carlson et al. (1990) found that education abroad participants tended to have traveled abroad previously. Much of the literature cited a lack of information and awareness of education abroad programs as a barrier for students to participate (Murray, Brux, Fry, 2010; Dessoff, 2006). Few studies have explored the associations between institutional type and students' likelihood to participate in education abroad. For example, Salisbury et al. (2009) found that students attending community colleges and regional comprehensive and research institutions were less likely to study abroad than students at liberal arts colleges. A gap exists in the literature to explore how different institutional settings could affect students' participation in education abroad, such as institutional selectivity, education broad policy, financial structure, university resources settings, etc.

4.2.2 Education Abroad and College Completion

Previous empirical studies have investigated the relationship between participation in education abroad and college completion (Johnson & Stage, 2018; Malmgren & Calvin, 2008; Hamir, 2011; O'Rear, Sutton, & Rubin, 2012; Xu, Silva, Neufeldt, & Dane, 2013). Studies conducted either within a single institution or across multiple institutions suggested participation in education abroad had positive effects on college completion compared with either education abroad applicants or non-education abroad participants using logistic regression analyses (Hamir, 2011; Xu et al., 2013; O'Rear, Sutton, & Rubin, 2012; Sutton & Rubin, 2010). Most studies have relied on two analytic approaches. Some used chi-square analyses to examine whether there were statistically significant differences in graduation rates between education abroad and non-education abroad participants (Hamir, 2011, Malmgren & Calvin, 2008). Several studies have conducted logistic regression analyses to examine the effect of education abroad on graduation after controlling for demographics and prior academic achievement factors (O'Rear, Sutton, & Rubin, 2012; Sutton & Rubin, 2010, Xu et al., 2013; Hamir, 2011, Johnson & Stage, 2018). However, a potential threat to internal validity—selection bias— has not been addressed in these empirical studies.

In an ideal experimental setting, the effect of participation in education abroad can be estimated by the simple difference in observed means of treatment and non-treatment groups (Thoemmes & West, 2011). Without a random assignment of an education abroad program, any assessment of the effect of participation in education abroad is subject to selection bias. Choosing to participate in an education abroad program depends on active choices of students or institutional settings, such as students' demographic characteristics, prior academic achievement factors,

institutional education abroad policy, etc. Thus, simply comparing education abroad and non-education abroad groups will likely cause a biased treatment effect estimate. One way to minimize the impact of selection bias is through the use of propensity score matching (PSM). PSM allows researchers to balance nonequivalent groups through matching on a singular scalar variable (Rosenbaum & Rubin, 1984). A few studies have also addressed the major issue of the selection bias within the field of education abroad and importance of employing a matching approach to select a comparison group (Haupt, Ogden, & Rubin, 2018; CASSIE, 2017). However, none of them have provided empirical evidence using propensity score matching. Additionally, none of the studies discussed the inclusion of institution-level characteristics to address the selection bias, as different institutional settings could affect students' likelihood to participate in education abroad. Thus, for studies across multiple institutions, it is important to include both student-level and institution-level characteristics to select a comparable untreated group using PSM.

4.3 The Current Study

For this current study, I merged two national datasets that were collected across multiple institutions. I first examined the association between both student- and institution-level factors and students' likelihood to participate in education abroad. The findings of the first step provide suggestions on what should be included in the PSM model to in order to select a comparable untreated group to reduce the selection bias while assessing the effects of participation in education abroad on bachelor's degree attainment. This study is unique in its attention to the participation and effects of education abroad by including both student- and institution-level characteristics while adopting PSM to reduce the selection bias that has existed in education abroad research.

4.4 Method

4.4.1 Data Source

Data used for this study were compiled from two large scale datasets: the Educational Longitudinal Study of 2002 (ELS: 2002) and the Integrated Postsecondary Education Data System (IPEDS). Administered by the National Center for Education Statistics (NCES), The ELS:2002 data was collected through surveying a nationally representative sample of students as they progressed from 10th grade and 12th grade to schooling beyond high and to workplace. The base year data was collected in 2002 when students were 10th graders. Follow-up surveys of the sampled students were administered in 2004 (1st follow-up), 2006 (2nd follow-up), and 2012 (3rd follow up). This study mainly included variables from the 1st and 3rd follow-ups. The responses to the 1st follow-up provided information on students' demographics (gender, socio-economic status, race) and previous academic achievement prior to colleges. The responses to the 3rd follow-up provided a rich source of data on college access, choice, activities, and degree completion.

The 2005 IPEDS survey data was used because it aligns with the same year in which students graduated from high school. Also administered by NCES, IPEDS surveys postsecondary institutions eligible for federal student financial aid and collects data on institution-level characteristics, such as institution type, selectivity, admission, tuition, resources, etc. I merged the ELS:2002 student-level data with the IPEDS institution-level data via a common institution identifier. I restricted the analytic sample to respondents with a transcript-based indicator of ever attending a four-year institution. The final data sample consisted of 6,700 students.

4.4.2 Measures

The outcome of interest in this study is bachelor's degree attainment. This binary outcome variable indicated whether a student ever attained a bachelor's degree from a four-year postsecondary institution. The main independent variable was education abroad participation, indicating whether a student ever participated in any education abroad program in college. I selected the confounding variables from both student- and institution-level based on prior literature on factors associated with education abroad participation for propensity score matching as well as college completion. The factors associated with education abroad participation were included in propensity score matching model to predict students' likelihood to participate in education abroad. For outcome estimate models, the confounding variables were controlled to examine the effects of education abroad on bachelor's degree attainment.

For student-level confounding variables, this study included measures of gender, race, socio-economic status, and prior academic performance, which were proven to be associated with participation in education abroad and college completion (Booker, 2001; Simon &Ainsworth, 2012; Luo & Jamieson-Drake, 2015; Astin & Oseguera, 2012; Attewell, Heil, & Reisel, 2011). For institution level variables, evidence has shown that institution type and selectivity were related to degree attainment and education abroad participation (Astin & Oseguera, 2012; Kim, 2007; Salisbury et al., 2009). Previous studies found that the academic or social climate of an institution was associated with student college engagement and degree completion (Rumberger, 1995). Institution expenditures, such as instructional expenditures, academic support expenditures and student service expenditures have also been studied as factors of college completion (Gansemer-Topf & Schuh, 2006; Ryan, 2004). A gap exists in the literature to explore how different

institutional settings could affect students' participation in education abroad, such as institutional selectivity, education broad policy, financial structure, university resources settings, etc. This study attempts to provide evidence on how participation in education abroad varies from institution to institution. Detailed descriptions of both student- and institution-level covariates were presented as follows.

Student-level covariates

Gender. This variable indicates whether students categorized themselves as female or male. In this data sample, 55.58% of the students were female (n=3,724) and 44.42% of the students were male (n=2,976).

URM. This binary variable indicates whether students categorized themselves as (a) Hispanic or Latino, (b) American Indian or Alaska Native, (c) Black or African American, or (d) Native Hawaiian or Other Pacific Islander. URM students comprised 25.16% of the data sample (n=1,686), while White and Asian students collectively represented 74.84% (n=5,014).

Socio-economic status (SES). This variable was a composite of five equally weighted and standardized components: father's/guardian's occupation, mother's/guardian's occupation, father's/guardian's education, mother's/guardian's education, and family income. The values for this variable in the data set ranged from -2.12 to 1.87, with a mean of 0.31 and a standard deviation of 0.71.

High school GPA. This continuous variable is a measure of average academic performance in all academic courses taken by a student from 9^{th} grade to 12^{th} grade in high schools, on a scale of 0 to 4. The mean GPA for this dataset is 3.00 with a standard deviation of 0.69.

Institution-level covariates

Institutional type. This categorical variable indicates the type of the postsecondary institution that a student attended based on data collected from the 3rd follow-up, which includes three categories: public (n=4,348; 64.96%), private not for profit (n=1,836; 27.43%), and private for profit (n=509; 7.60%).

Institutional selectivity. This categorical variable indicates the selectivity of the postsecondary institution that a student attended from the data collected during the 3rd follow-up, including four categories: highly selective (n=1,778; 26.57%), moderately selective (n=2,392; 35.74%), inclusive (n=858; 12.82%), and selectivity not classified (n=1,665; 24.88%).

Historically black college or university (HBCU). This variable indicates whether the institution that a student attended was a HBCU. In this data sample, 1.92% of the students were from HBCU (n=128), and 98.08% of the students were not from HBCU (n=6554).

Education abroad programs. This variable indicates whether the institution that a student attended provided any education abroad programs. 76.83% of the students attended institutions that offered education abroad programs (n=5,111), and 23.17% of the students attended institutions that did not have any education abroad programs (n=1,541).

Credits. This variable indicates whether the institution that a student attended accepted any advanced credits from high schools, such as dual credits, Advanced Placement credits, etc. In this data sample, 4.93% of the students attended institutions that accepted advanced credits taken from high schools (n=329), and 95.07% of the students attended institutions that did not accept any advanced credits from high schools (n=6,340).

Remedial services. This variable indicates whether the institution that a student attended provided any remedial services. 74.09% of the students attended institutions that provided remedial services

(n=4,941), and 25.91% of the students attended institutions that did not provide any remedial services (n=1,728).

Employment services. This variable indicates whether the institution that a student attended provided any employment services. 93.76% of the students attended institutions that provided employment services (n=6,253), and 6.24% of the students attended institutions that did not provide any remedial services (n=416).

4.4.3 Analytic Procedure

Utilizing a national longitudinal dataset, the goals of this study are to understand the profile of education abroad participation and to examine the effects of education abroad on bachelor's degree attainment across multiple institutions. To achieve the first goal of this study, I used bivariate analyses and binary logistic regression by including both student- and institution-level characteristics. The results of bivariate analyses reveal whether there is any significant difference in independent variables between education and non-education abroad participants. Binary logistic regression is a predicative analysis to examine the relationship between all of the student- and institution-level variables and participation in education abroad.

To examine the effects of education abroad on bachelor's degree attainment, I adopted a quasi-causal experiment research technique—propensity score matching (PSM)—to increase the internal validity of the study. As discussed earlier, participation in education abroad is not randomly assigned, but self-selected. Without a random assignment of the treatment, the examination of the effects of education abroad participation is subject to selection bias. Participation in education abroad can depend on students' demographic characteristic, prior academic achievement, institution-level available programs and resources, etc. PSM can balance

the nonequivalent treated and untreated groups through matching their propensity scores estimated all the observed characteristics (Rosenbaum & Rubin, 1984). Logistic regression appears to be the most commonly used approach to calculate the propensity scores.

The findings of the first research question of this study provides evidence on what covariates should be included in the logistic regression model to predict the propensity score for each individual student. The propensity score estimate model included all the covariates that were either found to be statistically significant predictors of participation in education abroad or in which there were statistically significant differences between education abroad and non-education abroad participants. Once the propensity scores were estimated, I used the nearest neighbor one-to-one matching within a specified caliper distance, in which a treated student would be only matched to one untreated student who had the closest propensity score to that of the treated student. For the caliper bandwidth, Rosenbaum and Rubin (1985) recommended that it should be no greater than 0.25 of the standard deviation of the propensity scores. Austin (2011) examined optimal caliper widths and suggested that using a caliper equal to 0.20 of the standard deviation of propensity scores minimized the mean square error of the estimated treatment effects. For this study, I set the caliper bandwidth as 0.20. I set up all the matching in this study without replacement, which means that once an untreated student has been selected for matching, it becomes unavailable for consideration as a potential match for any other treated students.

After the matching is done, it is important to assess the comparability of treated and untreated groups in a matched sample (Rosenbaum & Rubin, 1985; Austin, 2009). I first computed the absolute standardized difference or standardized bias, which compares the difference in means in units of the pooled standard deviation between treated and untreated groups before and after matching (Rosenbaum & Rubin, 1985; Austin, 2011). The percent bias reduction (PBR) is another

commonly used indices to check the balance of covariates between treated and untreated groups after matching (Cochran & Rubin, 1973). A PBR more than 80% is often used as a benchmark to indicate the matching is effective in reducing bias (Cochran & Rubin, 1973; Rubin, 1980). Additionally, I compared the distributions of propensity scores of treated and untreated groups before and after matching. I further examined the common area of support, in other words, the degree of overlap in the propensity scores between treated and untreated groups after matching. Through examining the common support, I was able to identify unmatched treated individuals that were excluded for the outcome analyses. By comparing the distributions of propensity scores and examining the common support, I was able to assess whether the means of covariates included in the propensity core model are similar between treated and untreated groups after matching (Austin, 2011).

Once the treated students were matched with the untreated students, I proceeded with the outcome analyses using the matched samples. For the dichotomous outcome variable—bachelor's degree attainment, I used binary logistic regression to examine the effects of education abroad participation on bachelor's degree attainment.

Although this study used datasets collected across institutions and included a few institution-level variables, the number of students within each institution was too small to employ a multilevel modeling to understand how institution-level variables interact with student-level variables to further affect students' participation in education abroad, as well as college completion. All the analyses described above were conducted using Stata SE/14.0 statistical software.

4.5 Results

4.5.1 Participation in Education Abroad

I first examined the differences that existed in all student- and institution-level independent variables between education abroad and non-education abroad participants. Table 1.1 illustrates the findings. For student-level characteristics, education abroad participants were more likely to be female (66.67%) and white/Asian students (84.59%) than non-education abroad participants (Female:53.91%; white/Asian: 73.37%). On average, education abroad participants had a mean score of 0.65 in SES, with a standard deviation of 0.67, which was 0.39 score points higher than non-education participants (M=0.26; SD=0.39). Education abroad participants had higher academic achievement in high school than non-education abroad participants, as measured by their high school GPA. On average, the high school GPA of education abroad participants was 3.34, with a standard deviation of 0.56, which was 0.39 points higher than non-education abroad participants (M=2.95; SD=0.69).

As to the institution-level characteristics, among the full sample, education abroad participants were 21.82 percentage points more likely to be from 4-year private not-for-profit institutions than non-education abroad participants; and were respectively 16.01 and 5.72 percentage points less likely to be from 4-year public institutions and 4-year private for-profit institutions than non-education abroad participants. Education abroad participants were 31.49 percentage points more likely to be from highly selective institutions; and were 6.27, 8.18, and 17.05 percentage points less likely to be from moderately selective, inclusive selective, and selectivity-not-classified institutions, respectively. Education abroad participants (1.03%) were less likely to be from HBCU than non-education abroad participants (2.05%). Not surprisingly,

students who participated in education abroad (89.68%) were more likely to be from the institutions that had education abroad programs than students who did not participate in education abroad (74.90%). A slight difference was found in whether the participating institutions accepted advanced credits or not between education abroad and non-education abroad participants. Education abroad participants (4.59%) were slightly less likely to be from institutions that accepted advanced credits than non-education abroad participants (4.99%). However, the difference was not statistically significant. Moreover, compared with non-education abroad participants, education abroad participants were less likely to be from institutions that provided students with remedial services, and more likely to be from institutions that provided employment services.

In addition, two-sample proportion tests and two-sample t-tests were conducted, respectively for categorical and continuous independent variables. All the differences in student- and institution-level independent variables between education abroad and non-education abroad participates were found to be statistically significant, expect for whether the institutions accepted advanced credits, as indicated in Table 1.1

Table 4.1 (continued) Descriptive Comparison of Education abroad (EA) and Non-Education Abroad (non-EA) Participants Across Independent variables

Independent Variables	Total Sample	EA	Non-EA	Difference
URM				
Yes	25.16%	15.41%	26.63%	-11.22***
No	74.84%	84.59%	73.37%	11.22***
Gender				
Male	44.42%	33.33%	46.09%	-12.76***
Female	55.58%	66.67%	53.91%	12.76***
SES	0.31(0.71)	0.65 (0.67)	0.26 (0.70)	0.39***
HS GPA	3.00 (0.69)	3.34 (0.56)	2.95 (0.69)	0.39***

Institutional type				
Public	64.96%	50.97%	67.07%	-16.01***
Private not-for-profit	27.43%	46.40%	24.58%	21.82***
Private for-profit	7.60%	2.63%	8.35%	-5.72***
Institutional selectivity				
Highly selective	26.57%	53.94%	22.45%	31.49***
Moderately selective	35.74%	30.29%	36.56%	-6.27***
Inclusive selective	12.82%	5.71%	13.89%	-8.18***
Selectivity not classified	24.88%	10.06%	27.11&	-17.05***
HBCU				
Yes	1.92%	1.03%	2.05%	-1.02*
No	98.08%	98.97%	97.95%	1.02*
EA programs				
Yes	76.83%	89.68%	74.90%	14.78***
No	23.17%	10.32%	25.10%	-14.78***
Accepting advanced credits				
Yes	4.93%	4.59%	4.99%	-0.40
No	95.07%	95.41%	95.01%	0.40
Remedial services				
Yes	74.09%	59.17%	76.33%	-17.16***
No	25.91%	40.83%	23.67%	17.16***
Employment services				
Yes	93.76%	96.44%	93.36%	3.08***
No	6.24%	3.56%	6.64%	-3.08***
Observations	6,700	876	5,824	

Note. For categorical independent variables, proportions were reported. For continuous independent variables, means and standard deviations were reported.

Two-sample proportion tests were conducted for categorical independent variables. Two-sample t-tests were conducted for continuous independent variables. The differences were reported in percentage points for categorical variables.

*P ≤ .05. **P ≤ .01. ***P ≤ .001.

Table 1.2 provides an overview on the effects of all the student- and institution-level variables on participation in education abroad, as reported by odds ratio. Eight out of fourteen variables included in the logistic regression model were found to be statistically significant predictors of students' participation in education abroad. On average, a male student was 0.546 times as likely to participate in education abroad as a female student, controlling for all the other student- and institution level independent variables. A student with higher SES was more likely to participate in education abroad than a student with a lower SES. On average, for one-unit increase in SES, a student was 1.734 times as likely to participant in education abroad. A student with higher high school GPA was more likely to participate in education than a student with a lower high school GPA. On average, for a one-unit increase in high school GPA, a student was 1.691 times as likely to participant in education abroad.

For institution-level characteristics, a student from a private not-for-profit institution was 1.717 times as likely to participate in education abroad as a student from a 4-year public institution. Students from the highly selective institutions had the highest likelihood to participate in education abroad. On average, compared with students from high selective institutions, students from moderately selective, inclusive selective, and selectivity-not-classified institutions were respectively 0.513, 0.311, and 0.269 times less likely to participate in education abroad. The last statistically significant institution-level predictor was whether the institutions accepting advanced credits that student took from high school. On average, students from institutions that accepted advanced credits were 1.788 times as likely to participate in education abroad as students from institutions that did not accept advanced credits.

Table 4.2 Logistic Regression Analysis of Estimates of Odds Ratio Predicting Participation in Education Abroad

Independent Variables	Odds Ratio	Standard Error
URM	0.843	0.092
Male	0.546***	0.453
SES	1.734***	0.111
HS GPA	1.691***	0.130
Private not-for-profit	1.717***	0.143
Private for-profit	0.995	0.268
Moderately selective	0.513***	0.049
Inclusive selective	0.311***	0.057
Selectivity not classified	0.269***	0.049
HBCU	1.809	0.689
EA programs	1.213	0.213
Accepting advanced credits	1.788**	0.400
Remedial services	0.885	0.885
Employment services	0.896	0.205
Observations	6,630	
Pseudo R^2	0.140	
Log-likelihood	-2211.590	
AIC	4453.179	
BIC	4555.169	

Note. *P ≤ .05. **P ≤ .01. ***P ≤ .001.

4.5.2 Propensity Score Matching

As indicated in Table 2, before matching, there were statistically significant differences between education abroad and non-education abroad participants in all covariates, except for the covariate that indicates whether or not the institutions accepting advanced credits. After matching,

the differences were no longer statistically significant. Overall, the percent of bias reduction in propensity score was 99.30%, which indicates a sufficient bias reduction. Moreover, Figure 1 indicates that the standardized bias decreased significantly across all covariates after matching. The distributions of the matched education abroad and non-education abroad students were much more comparable than those of the unmatched education abroad and non-education abroad students, as indicated in Figure 2. There was a substantial overlap of the propensity score distributions in the matched groups. Additionally, Figure 3 provides the common support for the range of propensity scores across education abroad and non-education abroad students. Most of the education abroad students were matched with a non-education abroad student with a similar propensity score, except for twenty education abroad students who were off support. In other words, there were no comparable non-education abroad students with similar propensity scores for these twenty education abroad students. The characteristics of these twenty students are presented in Appendix Table A. The potential threats to both internal and external validity caused by the exclusion of the six education abroad students in the outcome analyses will be addressed in the discussion session. Overall, after PSM, there was a comparable non-education abroad group selected for education abroad group to examine the effects of participation in education on bachelor's degree attainment.

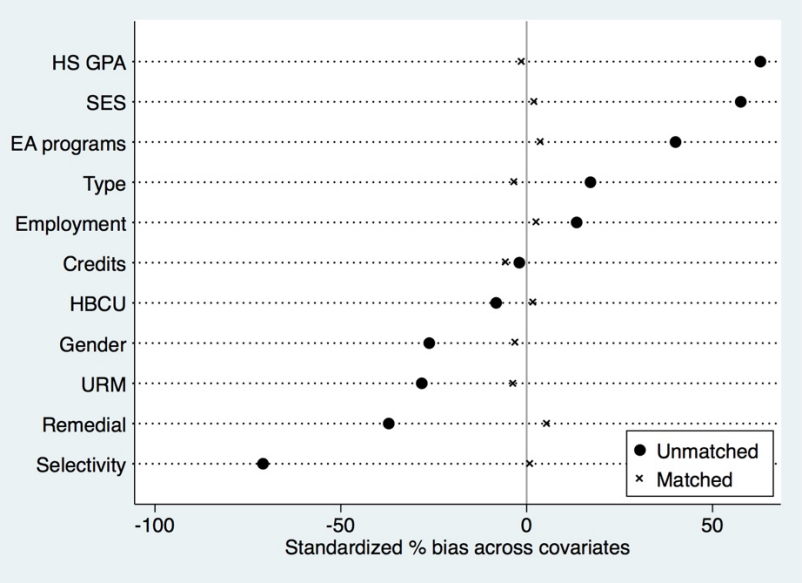

Figure 4.1 Standardized bias across covariates before and after matching for participation in EA

Table 4.3 Covariates Balance Results Before and After PSM for Participation in Education Abroad

	Before Matching				After Matching				
	EA	Non-EA	[1]Diff	SB (%)	EA	Non-EA	Diff	SB (%)	Reduction (%)
Propensity score	0.234	0.115	0.131**	103.7	0.231	0.232	-0.001	-0.7	99.3
Male	0.334	0.461	-0.127***	-26.2	0.342	0.357	-0.015	-3.2	87.9
URM	0.154	0.266	-0.112***	-28.2	0.156	0.170	-0.014	-3.5	87.5
HS GPA	3.344	2.950	0.394***	62.9	3.332	3.340	-0.008	-1.2	98.1
SES	0.653	0.258	0.359***	57.6	0.634	0.619	0.015	2.1	96.3
Type	1.512	1.410	0.102***	17.2	1.500	1.520	-0.020	-3.4	80.3
Selectivity	1.713	2.448	-0.735***	-70.9	1.730	1.722	0.008	0.8	98.9
HBCU	0.010	0.020	-0.010*	-8.2	0.011	0.008	0.003	1.9	76.7
EA programs	0.900	0.751	0.149***	40.0	0.897	0.883	0.014	3.8	90.5
Credits	0.045	0.049	-0.004	-2.0	0.044	0.055	-0.011	-5.6	-181.8
Remedial	0.591	0.763	-0.171***	-37.1	0.600	0.575	0.025	5.4	85.5
Employment	0.964	0.935	0.029***	13.5	0.966	0.960	0.006	2.7	79.9

Note. [1]For categorical independent variables, the differences in proportions were reported. Two-sample proportion tests were conducted. For continuous independent variables, the differences in means were reported. Two-sample t-tests were conducted.

*P ≤ .05. **P ≤ .01. ***P ≤ .001.

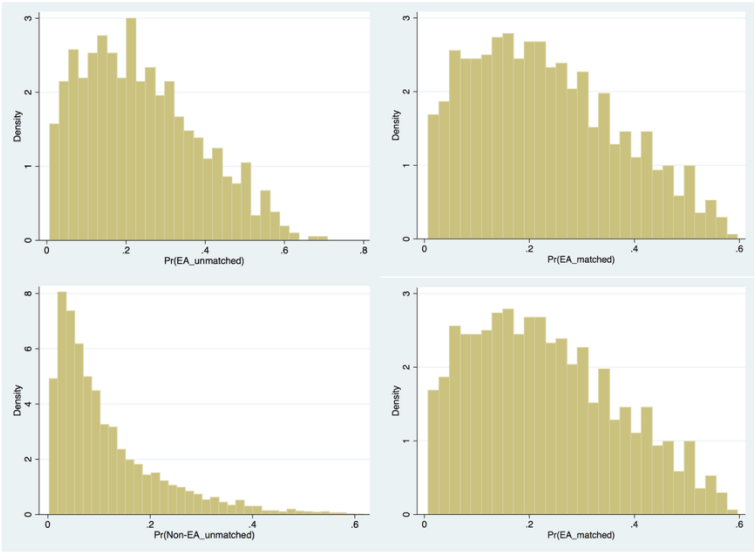

Figure 4.2 Histograms of propensity scores for EA and non-EA groups before and after matching

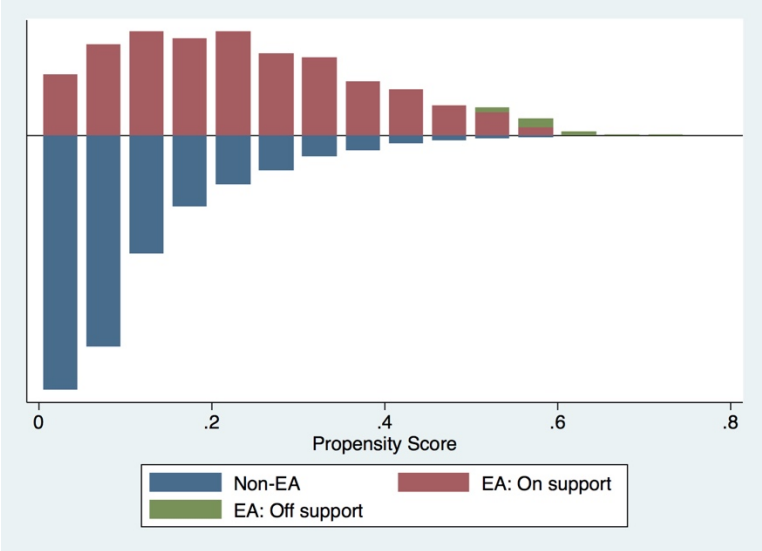

Figure 4.3 Common support of propensity scores between EA and non-EA groups after matching

4.5.3 The Effects of Education Abroad

Overall, participation in education abroad had a positive effect on students' bachelor degree attainment before and after matching, as shown in Table 1.2. After PSM, the effect was even greater. On average, an education abroad student was 1.663 times as

likely to attain a bachelor's degree than a non-education abroad student. With all the covariates being held at their means, the average predicted probabilities of attaining a bachelor's degree for education abroad and non-education abroad students were respectively 88.3% and 81.9%, as indicated in Figure 4. The difference of 6.4 percentage points was statistically significant.

Table 4.4 The Impact of Participation in Education Abroad on Bachelor's Degree Attainment

	Before PSM		After PSM	
	Odds Ratio	Standard Error	Odds Ratio	Standard Error
EA (OR)	1.571***	0.180	1.663**	0.236
[1]Covariates	YES		YES	
N (total)	6,630		1,696	
Pseudo R^2	0.252		0.169	
Log-likelihood	-3252.894		-669.395	
AIC	6537.787		1370.790	
BIC	6646.577		1457.766	

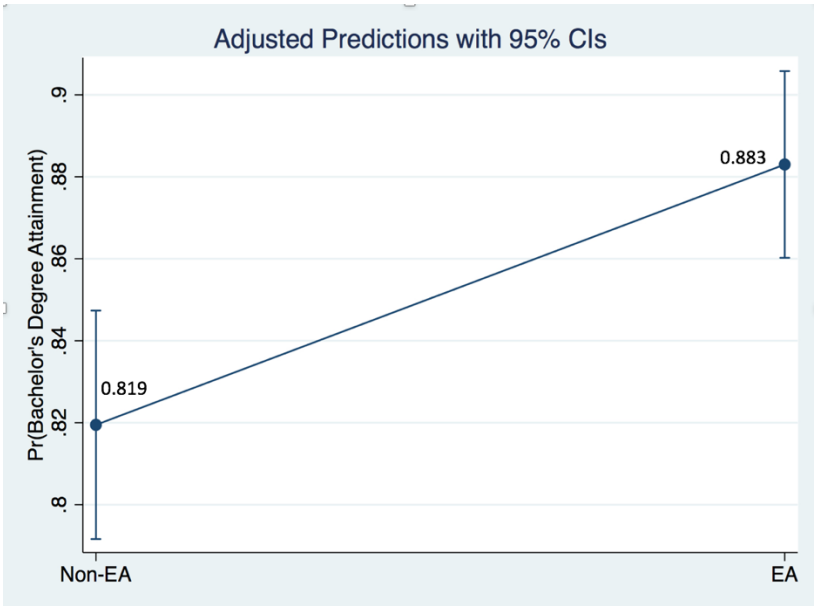

Figure 4.4 The average predicted probabilities of bachelor's degree attainment for non-education abroad and education abroad students

4.6 Conclusions

With growth and expansion of education abroad over years, there has been a need to understand education abroad participation profile to develop strategic policy and programs to promote broader student access and inclusion, as well as to assess the effects of participation in education abroad on student success. With this study, I merged two national datasets to include both student- and institution-level variables. I undertook this study to first examine the association between student- and institution-level factors and students' likelihood to participate in education abroad. Previous literature failed to make connections between participation in education abroad and different institutional characteristics, such as institutional selectivity, education abroad policy, institutional resources settings, etc. The findings of the first step provided direct suggestions on what should be included in the PSM model to select a comparable non-education abroad group that shared similar likelihood to participate in education abroad as the treated group. This study is unique in

its attention to the participation and effects of education abroad by including both student- and institution-level characteristics while adopting PSM to reduce the selection bias that existed in education abroad research.

The results of the study confirm and extend previous studies. As to student-level characteristics, this study supports findings of previous studies that female students were more likely to participate in education abroad than male students (Salisbury, Paulsen, & Pascarella, 2010, 2011; Dessoff, 2006; Stroud, 2010; Simon & Ainsworth, 2012). Although this study demonstrates that there statistically significant differences in race between education abroad and non-education abroad participants, race was not a significant predictor of participation in education abroad based on the results of logistic regression analysis. As expected, SES was found to be a statistically significant predictor of participation in education abroad. Student with higher SES were more likely to participate in education abroad, which aligned with the findings of previous research (Booker, 2001; Simon &Ainsworth, 2012). Additionally, the results of this study also support the previous findings that students with higher academic performances were more likely to participate in education abroad (Paus & Robinson, 2008; Luo & Jamieson-Drake, 2015; Salisbury et al., 2010, 2011; Thomas & McMahon, 1998).

Concerning institution-level characteristics, previous studies have only examined the relationship between institutional type and students' likelihood to participate in education abroad. By including a rich array of institutional-level variables from IPEDS dataset, this study contributes to the current literature by exploring how various different institutional settings affect students' participation in education abroad. With regard to institutional type, students from private not-for-profit 4-year institutions were more likely

to participate in education abroad than students from public and private for-profit institutions. Not surprisingly, students from highly selective institutions had the highest likelihood to participate in education abroad. Additionally, whether the institutions accepting advanced credits that students took from high school was also a statistically significant predictor of participation in education abroad. Students from institutions that accepted advanced credits were more likely to participate in education abroad than students from institutions that did not accept advanced credits. Logistic regression analysis found that the rest of the institution-level variables were not the statistically significant predictors of participation in education abroad, including whether the institution was a HBCU, whether the institution provided any education abroad program, whether the institution provided any remedial service, and whether the institution provided any employment service. However, statistically significant differences in each of these four variables were still found between education abroad and non-education abroad students.

Participation in education abroad was not randomly assigned, but self-selected. Thus, without addressing this issue, any assessment of the effect of education abroad participation is subject to selection bias. One way to minimize the impact of selection bias is through the use of propensity score matching (PSM). PSM allows researchers to balance nonequivalent groups through matching on a singular scalar variable (Rosenbaum & Rubin, 1984). The first part of the study provided direct suggestions on what student- and institution-level variables should be included in the PSM model to select a comparable non-education abroad group in order to examine the effects of participation. Overall, after matching, the differences in each observed variable were no longer statistically significant. There was a sufficient bias reduction. The results of this study confirmed that education

abroad as one of the high-impact practices enhances student success (Kuh, 2008). Overall, students who participated in education abroad in college were more likely to attain a bachelor's degree than students who did not participate.

Through including institution-level variables and addressing the methodological limitation in the literature, this study empirically demonstrates the association between institutional-level characteristics and students' likelihood to participate in education abroad and confirm that education abroad can positively impact college completion.

4.7 Discussion

Although the datasets that this study used were relatively out of date and the landscape of education abroad has changed over the past two decades, the ELS:2002 data is the only available national dataset for which I had access to study the effects of education abroad on college completion. Through merging two national datasets, this study presents a number of implications for education abroad professionals and policy makers, as well as for education abroad scholars. First, this study reveals both student- and institution-level factors that influenced students' participation in education abroad. Within each institution, education abroad practitioners should considering offering more flexibility, opportunities, and financial aid for students who are from less disadvantaged groups, such as low SES, URM, etc. Nationwide, it is important for the education abroad policy makers to understand how different institutional settings could affect students' likelihood to participate in education abroad in order to provide cost-effective and sustainable policies to promote education abroad participation across different institutions. Second, the findings of this study support that participation in education abroad can promote student success, in terms

of college completion. Thus, it is important for public policy makers to support colleges and universities in their efforts to promote student' participation in education abroad through increasing its accessibility and affordability. Colleges and universities should exert great efforts to increase education abroad opportunities, integrate more education abroad programs into their regular curriculum, and ensure its quality.

Although PSM helps increase the internal validity of education abroad research by minimizing the selection bias, this study itself by no means implies that there is a causal relationship between education abroad and college completion. PSM relies upon the strong assumption that the selection process is well explained by observable characteristics within the propensity score model. Even though I included all student- and institution-level observable variables that were available in the data set to predict the propensity scores, some other potential observed and unobserved characteristics affecting students' likelihood to study abroad still exist, for example, students' intent towards education abroad, students' openness to diverse ideas and people, their interests in cross-cultural experiences, as well as the variables that found to be statistically significant predictor of education abroad participation from paper 1, such as first-generation status, foreign language experience, major, etc. Additionally, the main independent variable—participation in education abroad—is a binary variable, but the length and purposes of each education abroad program are different. Without taking the variance of each education abroad program into consideration, researchers fail to get a robust estimate effect of education abroad on learning outcomes due to the threat to the internal validity of the studies. Moreover, after PSM, the sample size decreases. The findings of this study can only be generalized to a

population of students sharing similar observable characteristics, which decreases the external validity of this study.

This present study did not examine the varied effects of participation in education abroad across subgroups, such as URM students, first-generation students, etc. Thus, an extension to this study is to examine whether participation in education has a bigger impact on college completion for students from less advantaged subgroups. Although this study used datasets collected across institutions and included a few institution-level variables, the number of students within each in institution was too small to employ a multilevel modeling to understand how institution-level variables interact with student-level variables to further affect students' participation in education abroad, as well as college completion. Thus, for future research on education abroad using clustered datasets, it can a direction to conduct a multilevel modeling.

CHAPTER 5. OVERALL CONCLUSION

The results of the dissertation suggest a few implications for the theories underlying the conceptual model and the methodological limitations existing in previous literature, which contributes to understanding education abroad participation and outcomes. For education abroad participation, the large body of the previous research focuses on the student-level characteristics associated with students' participation in education abroad (Dessoff, 2006). However, institutional-level characteristics could potentially influence students' participation in education abroad and impact future broader outcomes, for example, the institutional type, selectivity, education abroad opportunities, other institutional support, etc. Altogether, the first and the third paper explored the differences in education abroad participation across students, colleges (within each institution), and institutions. Findings presented in both studies not only contribute to the literature on the factors associated with education abroad participation, but also inform future education abroad assessment research when selecting a more comparable non-education abroad group.

Methodologically, the first paper used both logistic regression and CART analyses to understand the education abroad profile by reconciling the differences of results from both methods in order to make a credible knowledge claim by examining the same data at hand. Logistic regression was able to examine the average effect of each independent variable on the likelihood to participate in education abroad, while CART was able to capture the complex interactive effects among independent variables and present the effects

in an intuitive way. Data used for the 3rd paper were compiled from two large-scale datasets: ELS:2002 and the 2005 IPEDS survey data. Although the datasets were relatively out of date, using longitudinal large-scale datasets collected across the nation was able to increase the external validity of the study.

The second and the third paper employed an advanced statistical technique – propensity score matching (PSM) – to get a better estimate of treatment effect of education abroad on graduation rates and bachelors' degree attainment by selection a comparison group who shared similar likelihood to participate in education abroad as the treatment group. Additionally, the 2nd study employed PSM to explore how education abroad duration and times of education abroad experiences impact graduation rates. Through addressing methodological limitations in the literature, this study empirically demonstrates that education abroad can impact college completion. In this way, both studies encourage researchers to use advanced matching methods to reduce selection bias while assessing the education abroad outcomes.

Even though this dissertation provides answers to the research question proposed, limitations of this dissertation remain. PSM helps increase the internal validity of education abroad research by reducing the selection bias, but these studies by no means imply a causal relationship between education abroad and college completion. First, using PSM to match education abroad and non-education abroad participants based on their similar propensity scores relies upon the strong assumption that the selection process is well explained by observable characteristics within the propensity score model. However, some other potential observed and unobserved characteristics affecting students' likelihood to study abroad still exist, for example, students' intent towards education abroad, students'

openness to diverse ideas and people, their interests in cross-cultural experiences, etc. Second, after being matched, the sample size decreases. The findings of this study can only be generalized to a population of students sharing similar observable characteristics, which decreases the external validity of this study.

The second and the third study used a greedy matching approach—nearest neighbor matching within a caliper—to select comparable comparison groups for each treatment. Users of this approach can encounter a dilemma between incomplete matching and inaccurate matching (Rosenbaum, 2002; Parsons, 2001). To solve the problem within the conventional framework of propensity score matching, the recommended procedure for future research is to test different propensity score prediction models and conduct sensitivity analyses by varying the size of the common support region (Guo & Fraser, 2015). This present study did not examine the varied effects of participation in education abroad across subgroups, such as URM students, first-generation students, etc. Thus, an extension to this study could be to examine whether participation in education has a greater impact on college completion for students from less advantaged subgroups. Although this study used datasets collected across institutions and included a few institution-level variables, the number of students within each in institution was too small to employ multilevel modeling to understand how institution-level variables interact with student-level variables to further affect students' participation in education abroad, as well as college completion. Thus, for future research on education abroad using clustered datasets, it can a direction to conduct a multilevel modeling. In addition, although the 2nd and 3rd study concluded that there education abroad boosted college completion, the mechanism of how education abroad affects college completion still needs to be explored. Future

research should build on Astin's and Tinto's theories to examine what factors mediate the relationship between education abroad and college completion.

The findings of this study lead to a number of important insights for education abroad professionals and policy makers who advocate for participation in education abroad, as well as for education abroad scholars to understand the relationship between education abroad and college completion from an advanced methodological perspective. The first and third study reveals a range of barriers that are associated with students' participation in education abroad participation. The gap in education abroad between male and female students is replicated in both studies. This finding suggests that efforts are needed to boost male participation by examining how each gender is socialized to enhance their educational experiences during college. Contrary to previous studies, the first study found that URM students are more likely to participate in education abroad than white and Asian students and the second study found that race was not a statistically significant predictor of education abroad participation. Both studies found that academic performance is a very important factor associated with students' participation in education. This suggests that education abroad offices may consider creating flexibility regarding eligibility requirements for students to participate in education abroad to make sure all students, not just the academically advanced students, have access to study abroad. Not surprisingly, both studies present that financial background is a significant factor influencing student's participation in education abroad. Given the realities of a tight university budget, universities may consider providing more funding opportunities for low-income students to ensure that finance will not deter them from participating in education abroad. By understanding the association between institution-level characteristics and education

abroad participation, it's important for the education abroad policy makers to understand how different institutional settings could affect students' likelihood to participate in education abroad in order to provide a cost-effective and sustainable to promote education abroad participation across different institutions.

The findings of the second and the third study support that education abroad participation can promote college completion, measured by 4-year and 6-year graduation rates and bachelor's degree attainment. Thus, it is important for public policy makers to support colleges and universities in their efforts to make participation in education abroad accessible and affordable. Colleges and universities should exert great efforts to increase education abroad opportunities and integrate more education abroad programs into their regular curriculum. The second study found that short-term education abroad programs had greater effects on college completion than other types of education abroad programs. In general, short-term education abroad programs are more affordable than longer programs and are more flexible, especially for students in structured academic programs like engineering and nursing to study abroad without falling behind in their programs. Therefore, promoting participation in short-term education abroad programs and ensuring their quality is critical.

In sum, the empirical evidence resulting from these studies informs higher education stakeholders when making decisions to increase or decrease the investments and efforts in education abroad infrastructure and scholarships. The findings of these studies could also help institutional leaders to diversify the participants of education abroad, especially non-traditional students, and to identify and expand the types of education abroad experiences that most benefit students. Students and parents will also benefit from

the findings to aid them in making better choices in terms of academic trajectories when students plan to study abroad.

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PUBLICATIONS & PRESENTATIONS

Dai, J., Sampson, S., & Peabody, M. (Under Review). Applying the Rasch Model to Examine the Mathematics Teaching Efficacy Beliefs Instrument. *School of Science and Mathematics Journal.*

Sampson, S., **Dai, J.**, & Hollen, L. (2020). *Exploration of the Psychometric Properties of Formative Assessment Items Developed by Teachers for Teachers.* Paper accepted at the Annual Meeting of the American Educational Research Association (AERA), San Francisco, CA, USA.

Dai, J., & Sampson, S. (2019). *Applying the Rasch Model to Bring Broder Insights to an Existing Scale: Measuring Teachers' Math Efficacy.* Paper presented at the Annual Meeting of the American Evaluation Association (AEA), Minneapolis, MN, USA.

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Dai, J., & Slaymaker, K (2019). *A cross-cultural orientation for resident advisors: Cultivating an engaging living and learning community for international students.* Poster presented at the Annual Meeting of the NAFSA: Association of International Educators, Washington, DC, USA.

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